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WORLD CROPS

The International Journal of Agriculture

VOLUME 13, No. 3 MARCH 1961

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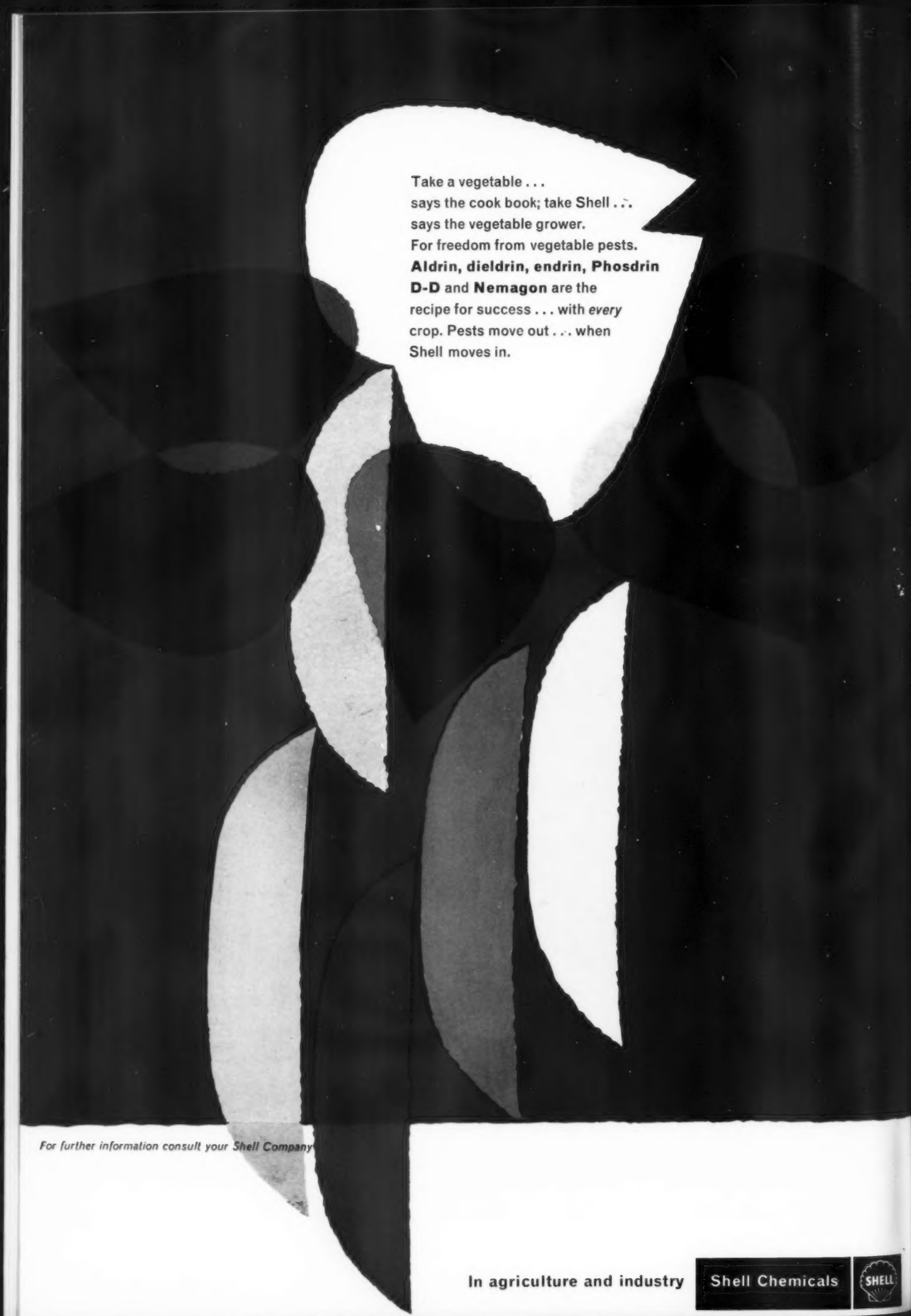
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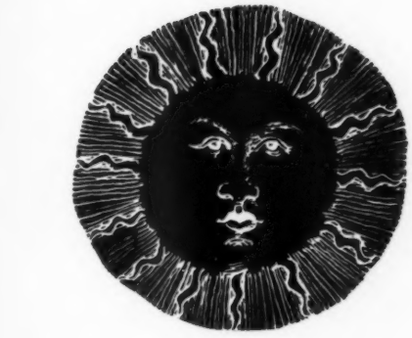

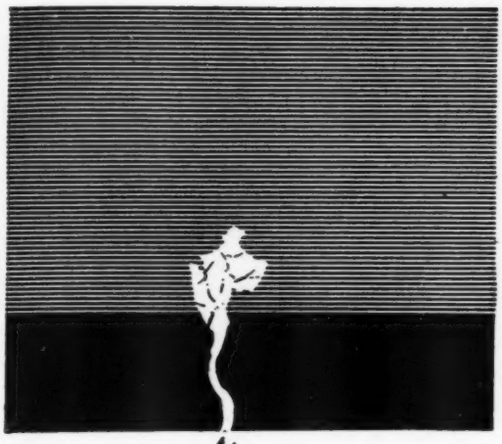

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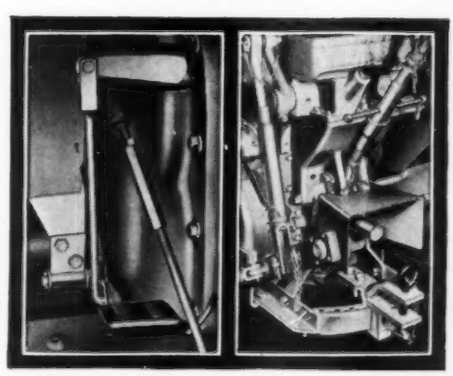

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RIGHT: The robust drawbar provides high and low hitch points and radial adjustment in the horizontal plane.

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The Pyrethrum Board of Kenya, the largest producers and distributors of pyrethrum in the world. Complete information is available from: The African Pyrethrum Technical Information Centre Ltd., 215-217 Grand Buildings, Trafalgar Square, London W.C.2 (Tel.: TRAfalgar 4288) and P.O. Box 420, Nakuru, Kenya Colony.

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1961

Editorial Comment

Power to Compete

AGRICULTURAL progress through the ages has owed a great deal to the time-honoured farming practice of leaning on a neighbour's gate and 'talking shop'. Nowadays agricultural conferences provide this valuable exchange of ideas.

The National Power Farming Conference, which was organised by the *Farmer & Stock Breeder Publications Ltd.*, took place in Brighton last month and not only attracted farmers and growers, but also agricultural engineers, research workers, manufacturers of farm machinery and many overseas visitors and students, and in all over 1,000 delegates attended.

Mr. J. M. A. Smith, Assistant Managing Director of the *Ford Motor Co.*, spoke on the theme 'Power to Compete'. Among those who followed him was Wiltshire farmer Mr. W. E. Cave, who spoke on the use of maize as a fodder crop; Mr. T. Garbett, of *Farrow & Sons Ltd.*, then gave a paper on 'Organic Irrigation' and an American, Mr. J. F. Ziskal, of the *International Harvester Co.*, discussed the applications of hydraulics in agricultural operations. Papers on 'Sprays and Spraying' were given by Mr. A. L. Abel, of *Fisons Pest Control Ltd.*, and a Hampshire spraying contractor, Mr. M. B. Dodson.

These are but a few of the many papers presented, but they are sufficient to show the range of operations that are now covered by the expression 'power farming'.

Rice Yield Fluctuations

CONCERN WAS expressed some 12 years ago over the decline in rice yields in Asia and in some quarters it was suggested that this was due to exhaustion of the land as a result of continuous rice cultivation. This explanation was unacceptable, for most of the land had been continuously planted with rice for so many years that yields must long ago have reached a state of equilibrium. The fact was perhaps overlooked, until the Baguio Rice Meeting of FAO in 1948 pointed out that about 15 million acres of rice land was abandoned during the war. Shortage of machinery, of equipment and of working cattle and the unsettled political situation in the East hampered recovery.

Writing in 1948, FAO stated that 'lack of good seeds, fertilisers and other production requisites continues to affect productivity of the rice land under cultivation'. FAO and other authorities stressed the importance of increased use of fertilisers, although the opinion was expressed in one quarter that the correct order of importance was improved drainage and irrigation, more effective control of pests, the addition of organic matter to the land—with or without fertilisers—and the selection and breeding of improved varieties.

The time is now opportune for a reassessment of the situation, for a recent FAO report* shows that in the last decade improvement in yields in Asia has been a more important factor in raising production than increased area—on about one-half of the total area planted to rice in Asia the increase was about 20%. No single factor is responsible for this improvement, although the great extension of irrigation and drainage must rank as of primary importance.

FAO now appears to have transferred priority of importance from breeding new varieties and the greater use of fertilisers to improved drainage and irrigation, as, the report states, probably no single factor can affect rice production to the same extent as the provision of controlled irrigation, thus permitting an extension of double cropping, more effective use of fertilisers and improved seed.

Double Cropping or Rotation

There remains the enormous disparity of yields between one country and another—from over 3,000 lb. of milled rice per acre in some countries to about 750 lb. in others. There seems little doubt that this great difference is due largely to latitude, but it is significant that the highest yields are obtained in countries where rice is grown in rotation with other crops.

Far from adopting this system in Asia, the present tendency in the East is strongly towards growing two rice crops annually on the same land year after year—the 'double cropping' system. This system has for long been common in parts of Asia and is technically possible by means of controlled irrigation and drainage. It may result in greater production of rice than at present, but the same result can probably be achieved by raising one annual rice crop, provided that there is control of irrigation and drainage and that correct cultivation techniques and suitable varieties are employed.

Double cropping must tend towards a build-up of pests and the encouragement of diseases; it is, in fact, a denial of an elementary principle of agriculture. Before general extension of the double-cropping system it should be carefully compared with the rotational system. The improved control of irrigation should greatly facilitate the introduction of rotations on rice lands, for it makes possible the cultivation of a number of crops on land which hitherto has been considered useless for any crop except rice.

* Commodity Reports. Rice No. 11 August, 1960. FAO, Rome. Price U.S. $0.25 or 1s. 3d.

Individualism and Collectivism

BEFORE THE war Yugoslavia, on the Adriatic, was one of the most completely peasant countries in Europe, no less than 80% of the population being classed as agricultural. As is usual in these peasant countries, there was little outlet for the young people and many had to emigrate. Then came the war, when Yugoslavia's losses, both in people and in property in relation to the size of its population, exceeded those of any other country. After the war the partisan leader, Josep Bioz, better known as Tito, took charge and set up a Communist government.

Reconstruction is a colossal task, but the country has its natural advantages. There are large areas of well-watered fertile plains suited to agricultural production; the long stretch of the Adriatic coast is very attractive to tourists; and there is abundant water power whereby vast quantities of electricity can be generated for industrial purposes.

When President Tito first assumed power, reconstruction, both in town and country, was on Communist lines following the Russian model, but the peasants would have none of it. Doctrinaire politicians insisted that collectivisation must be forced upon them at all costs: competent officials who knew the peasants discovered that their duty to the State required them to sit tight in their offices; the new agricultural directors were ideological purists without technical knowledge and some great blunders were made. The peasants revolted and won.

The collective farms were dissolved, the peasants were allowed to take back the stock and implements they had been compelled to bring in and to set up their smallholdings again, but, as their numbers had meanwhile increased, no one was allowed to own more than 25 acres of cultivable land. Compulsory deliveries of produce to the State at fixed prices ceased and the peasants were promised that never again would the system be introduced.

Thus the country now presents the unorthodox spectacle of a Communist urban and an individualistic rural life developing side by side. This deviationist situation has naturally resulted in a break with Russia.

The Will To Succeed

The re-establishment of the peasant holdings, however, necessitated rapid improvement of the peasant output of food. Maize had long been the principal bread corn, but the new industrial proletariat began to demand wheat. Yields of wheat, however, were low—only about 8 cwt. per acre—and considerable import was necessary, eating up much-needed foreign currency.

Some State farms had been retained and these have been developed as experiment and demonstration stations with, however, the condition that they must pay their way. With this restricting condition, variety and selection trials, combined with fertiliser experiments, were found to be the safest lines, and these have already led to the introduction of high-yielding Italian wheats which promise greatly to increase existing yields. There has also been a marked increase in the consumption of fertilisers and a consequent rise in output of other produce, particularly in numbers of cattle, according to a letter from Sir John Russell.

The tourist industry on the coastal belt is being greatly developed and for miles round occupies the peasants in growing vegetables and fruit and in making wine. The produce is adequate, though of not particularly high quality, but retail prices are obtained, as it is sold direct to the consumer in the open markets by the women.

Co-operative marketing is beginning, but has not yet made much progress. The farms are small: 70% of them are only 12½ acres or less and none are above 25 acres. The agricultural work is falling increasingly on the women, as the men drift to the factories in the towns. Everywhere, both in town and country, Sir John found a grim determination that the resources of the country must be developed so as to give the people a fuller and richer life than they have ever had before.

Overseas Agricultural Service

THE TROPICAL PRODUCTS INSTITUTE in London is both a research laboratory and an advisory bureau and its purpose is to further the development and utilisation of the renewable resources of the tropics and sub-tropics.

We understand that members of the staff make frequent visits to overseas countries to investigate problems arising in the production, processing, storage and marketing of tropical products and send back material for examination and investigation in the laboratories.

Typical of the problems undertaken was the investigation of the causes of irregular bleaching of Nigerian palm oil. This was found to be due to bruising the fruit with subsequent delays in processing, resulting in chemical changes in the derived oils.

The island of Antigua in the West Indies was given advice on the design of a factory for processing maize, and that factory is now in operation.

A third significant example—the important pyrethrum industry in Kenya was founded on the advice which the Institute gave to a planter in 1928 when he asked for suggestions for possible new cash crops.

This, indeed, is typical of what is also happening today, for the research laboratories of the Institute are conducting a systematic examination of wild tropical plants used for making native medicines in the hope that new drugs will be discovered which may form the basis for new industries.

For those in search of knowledge, the extensive library containing over 150,000 books on various aspects

of tropical agriculture and agricultural production and the card index with some half a million references will provide a mine of information. Visitors from overseas are made particularly welcome.

More about Peas

THREE PROMINENT East Anglian farmers recently visited the largest pea-growing areas in the world, at Walla Walla and Mount Vernon in Washington State in the extreme north-east of the U.S.A., the tour being arranged by Birds Eye Foods Ltd.

The first remarkable difference they noted was in the size of the operations, the acreage per grower being between 250 and 4,000 acres, compared to areas of from 10 and 100 acres in the U.K. The total area under peas in U.S.A. in 1960 was 376,000 acres; in Britain it was about 70,000 acres.

The second was that the vining is done in enormous 'parks' located beside the quick-freezing factories, so that the flow of peas is a continuous operation from the moment they are brought in on the vine in lorry loads. Vining is not done in the field by travelling viners.

There are enormous silage dumps beside the vining parks. The silage is carried and dumped into two parallel roadside mangers, hundreds of yards in length and used to feed herds of cattle which are owned co-operatively by the pea farmers. One interesting point was the use of twin-tyred tractors to give stability and ensure the uniform compression of the silage.

The lorries used to bring in the vines had hopper-type bodies, with hydraulically-operated sides and ends which compress the contents, and function something like the Trojan 'Bale-Master'.

We would suggest to our Asian readers, that it is time that deep-frozen pineapple was sent to Britain in exchange for deep-frozen peas sent in the same freeze storage, for Hawaii was producing deep-frozen pineapple segments as long ago as 1949.

Radioactive Contamination

SINCE 1957 responsibility for investigation in Britain of the contamination of human food, agricultural crops and pastures with radioactive substances has been entrusted to the Agricultural Research Council, who published the first report of the Radiobiological Laboratory, ' Strontium 90 '.*

This is an account of a world-wide survey of the level of strontium 90, due to radioactive contamination, in samples of flour, potatoes and green vegetables, paying particular attention to special areas where the concentration might be expected to be above average. Milk has been examined more extensively than any other food because it is generally the sole diet of infants.

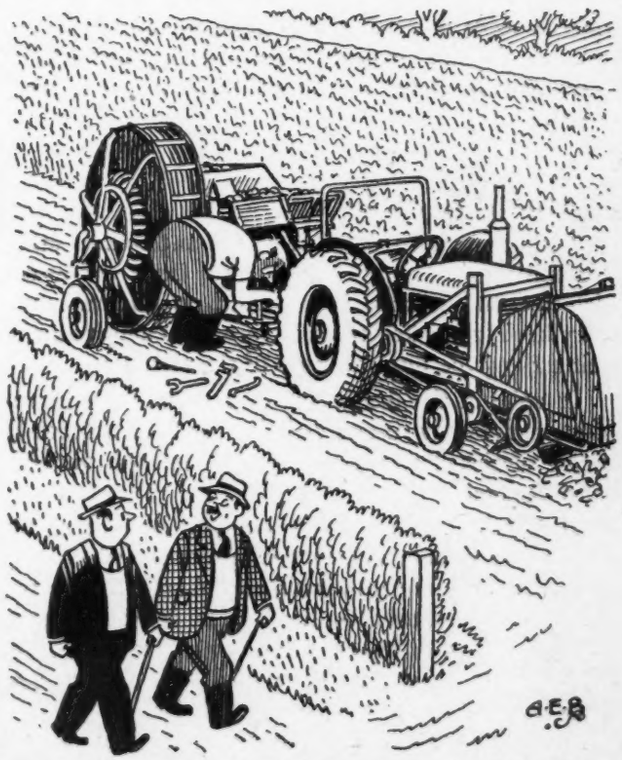
The report, which is supported by facts and figures, is very reassuring so far as the population as a whole is concerned, but it is important that no realistic estimate of the contamination of food and milk in the most highly contaminated special area (WORLD CROPS, 1958, 11, 3) was possible because most of the milk and vegetables consumed was obtained from other areas.

The interest in such special areas does not, however, lie in the average exposure, but in the maximum exposure which any one individual could conceivably receive if he consumed nothing but contaminated food and milk.

The Medical Research Council has concluded that the level of strontium 90 in the bones should not exceed 100 micro-microcuries per gramme of calcium. A theoretical calculation, based on the highest levels of contamination recorded in the milk and vegetables from all localities, gives the highest conceivable upper limit as 23 micro-microcuries per gramme of calcium in the total diet. This is sufficiently reassuring in itself, particularly as there is no evidence of a diet approaching this level being consumed by even a few persons and there is no evidence of a serious cumulative build-up in the body with long exposure.

Induced Mutations in Plants

IN 1927 two American scientists, Drs. Muller and Stadler, working respectively on *Drosophila* and barley, discovered that ionising radiations could cause heritable changes or mutations in living organisms. The



'Ah, potato picking was a real backaching job in the old days before we had machines for it'

*Published by H.M.S.O. London, 1959. 4s. net.

early reluctance to enter this field of study has been due, in part, to the fact that geneticists were sceptical that any, other than deleterious changes could be so induced. Pioneering work by German and Swedish workers has helped to overcome some of this early scepticism, but it was the post-war programme of atomic research and the greater availability of sources of ionising radiations that has given a final impetus to programmes of research on the production and utilisation of induced mutations in crop plants.

A description of the chemical, physical and biological factors involved, the forms of radiation employed and an account of the results obtained to date, have been given by Dr. D. R. Davies, of the Wantage Radiation Laboratory, in an address to the Royal Society of Arts in London.

He said: Most mutations, whether spontaneously or artificially induced, are deleterious and of no value to a plant breeder; in fact, it has been estimated that possibly only one out of every 800 induced mutations could be potentially of value. This rare occurrence of the event sought necessitates growing very large populations of plants, and in such large populations a detection and recognition of the desirable change may be difficult. If mutants exhibiting such obvious changes as differences in height, colour or even disease resistance are sought, then the problem is minimised, but more subtle changes such as those in yield are not as easily found.

Another difficulty which arises when this technique is adopted is that induced chromosomal damage frequently leads to sterility or even an elimination of the cell, bearing the damaged chromosomes, and both of these factors result in the non-recovery of mutant genes.

Breeding by Mutation

Nevertheless, in spite of these and many other difficulties, useful mutations have been produced, detected and utilised in breeding programmes, and they have stimulated research into ways and means of minimising the disadvantages of the technique.

In spite of the inefficiency of the techniques for inducing mutations, useful variation has been induced in many species of crop plants and a few new varieties have resulted.

In Sweden, barley, wheat, oat, pea, soya bean, flax and mustard mutants have been produced which vary in yield, straw strength, earliness and other characters, and new varieties have resulted in some instances. These include a higher yielding white mustard, oilrape and pea, and a stiffer strawed variety of barley. One interesting report from Sweden claims that they have produced barley mutants which flower earlier and hence can be grown in more northerly latitudes—such variants not being available to them previously. From Germany, plant breeders have reported cereal variants having higher grain yield, up to eight days earlier flowering, stronger straw, higher protein content and improved disease resistance. In Britain a self-fertile form of cherry has been produced from the normally self-sterile type, that should be less dependent on insects for pollination and therefore give a better yield in colder regions and unfavourable seasons.

In summarising so briefly the position of mutation breeding today, we need to remember that in Britain there is, in general, very little enthusiasm for the technique, and that in America the mood of tremendous optimism of a few years ago has changed to one of extreme caution. In Sweden and Germany, where during the last 20–30 years so much has been done to exploit the technique, there is much optimism that it can make a significant contribution to plant breeding. Elsewhere the tendency is for enthusiasm to be inversely related to knowledge and experience of the technique. As yet a total of only seven new varieties have been produced by mutation breeding, and even in their production, conventional breeding techniques have still played a large part.

Bridging the Gap

'THE SUCCESS OF the LEONARD HILL TECHNICAL GROUP is based upon pioneering and innovation. In this tradition, the Group has introduced over the past 11 years five new journals which bridge the gap between invention and practical exploitation. They are WORLD CROPS (1949), CORROSION TECHNOLOGY (1954), AUTOMATION PROGRESS (1956), CONFERENCES AND EXHIBITIONS (1956) and BUILDING MATERIALS EXPORT (1958). The first journal ever to be published for the food manufacturing industries was FOOD MANUFACTURE, which was published by this house in 1927.'

The above quotation, taken from a recent issue of *World's Press News & Advertisers' Review*, neatly summarises the purpose of these journals and the reason for their existence.

Telling the World

Just as the editorial matter in WORLD CROPS provides an essential link between the men of science and the practical farmer and plantation manager, so also does this journal play a vital role in bridging the gap between the manufacturers of agricultural machinery and chemicals and the users and consumers and potential buyers of these products in all parts of the world.

Today this journal is playing an essential part in the development of overseas trade. Companies who are really determined to maintain productivity and employment and are really interested in selling abroad are using WORLD CROPS for their advertising in their current campaigns.

PROGRESS THROUGH POWER FARMING

Increasing Production in the Under-Developed Countries

A. B. P. G. BEHR,* B.SC.(AGRIC.), A.M.I.AGR.E. GRAPHS AND DRAWINGS BY A. A. D'SOUZA, B.E.

The author has spent five years in India closely observing Indian farming. His article attacks a form of thought as misguided as that which caused the 19th-century riots in Britain which resulted in the burning of the first threshing machines by farm workers fearful of a threat to their livelihood which has not materialised.

BY making use of all the resources available to him the farmer in the more advanced countries of the world has been able to take on his shoulders production burdens that would have been thought impossibly large as recently even as 50 years ago. In the early days, for instance, the average American farm worker provided food for four persons. By 1950 the average American farm worker produced sufficient food for 25-30 persons. This achievement has conferred on American citizens the highest standard of living in the world.

It is no accident that better living standards have soared in parallel with increasing farm productivity, for the direct relationship between the two constitutes an inexorable law offering the highest hopes—or virtually a death sentence—to America's undeveloped world neighbours.

Over 250 special paddy disk harrows of the type shown here have been sold to Indian rice farmers during the past four years. With this equipment a satisfactory puddle can be obtained at the rate of an acre every 1½ hours and at a cost, established in special experiments carried out by the Central Rice Research Institute at Cuttack, near Calcutta, of Rs. 8s. per hour

In India today

Let us consider the extent of progress in these directions in India—a low-income, high - population country, unanimously considered critical in the ideological struggle absorbing world interest today. The lessons that are being learnt in India offer encouragement and provide guidance to all concerned with the economic development of low-income countries.

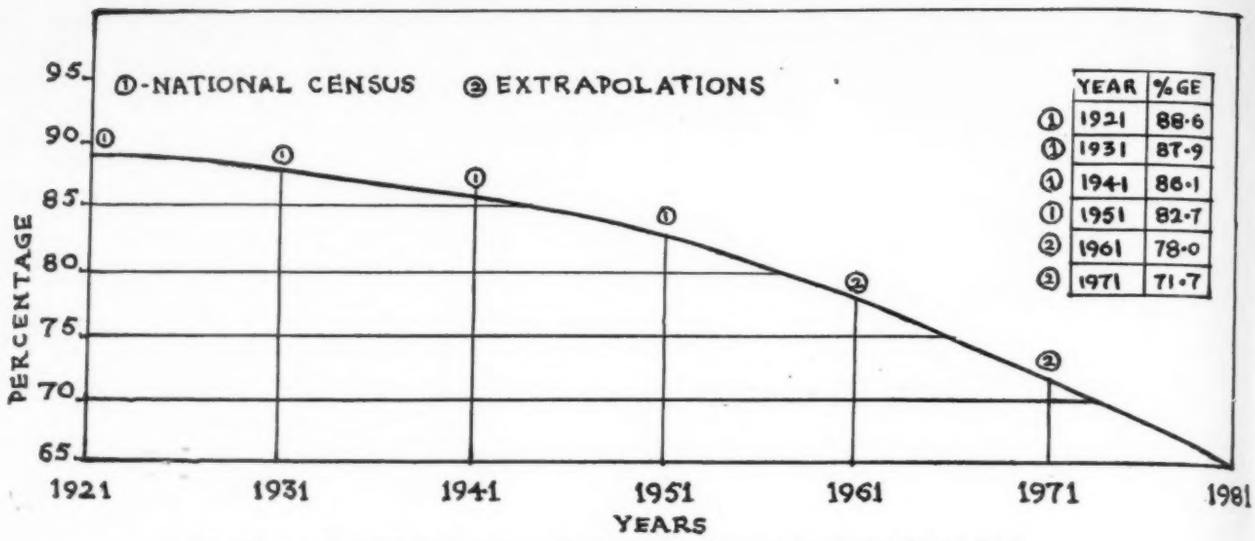
The draft outline of the Indian Third Five-Year Plan, released in June 1960 summarises very clearly the minimum achievements necessary if the country as a whole is to enjoy economic independence. Perhaps more important is the promise of release from the conditions of grinding poverty that afflict all but a small percentage of the population.

The draft states that further progress is possible only through the successful attainment of production goals assigned to the agricultural sector of the nation. There is a solemn realisation that failure to meet these goals will result in widespread privation and even in starvation.

Food production targets

Nearly 90% of the 320 million acres of Indian farmland is sown to food grains of various kinds. Naturally enough, it is within this category of farm production that progress is almost solely expected and required in the immediate future. Mr. S. K. Patil, Indian Minister for Food and Agriculture, has created a programme (dovetailed with the Third Plan) for virtual self-sufficiency in food supplies by 1966, the final year of the plan. Graph 3 shows the target of 105 million tons of food grains required by that date.

* Marketing Manager, Tractors and Farm Equipment Private Ltd., India.



Graph 1. Rural Population as Diminishing Percentage of Total Population

Consideration of the fact that food grain production in 1959, India's best year ever, was no more than 73 million tons emphasises the gravity of the Third Plan proposals. Very great advances in production must be accomplished if food supplies are even to rise neck and neck with anticipated population increases.

It follows that an unavoidable policy to restrict the agricultural sector of the nation in this dire emergency to the mere production of food grains must handicap developments based on farm surpluses or on the increasing use of agricultural raw materials in industry. Such restrictions must, for a significant period, limit drastically the value of the national diet.

Looming food shortages

Lack of attention to the agricultural sector in the First and Second Five-Year Plans has allowed the dread prospect of a looming food shortage to overtake the planners. In considering this question in a world context, the distinguished economist, Kenneth Boulding,[1] has written: 'Economic development has been thought of too much in terms of industrialisation, and it has not been realised that industrialisation can only be based on an increase in the food sales from agriculture'.

Only as a result of bitter experience has India learnt that economic progress starts on the farm.

Farm work capacity in India

Most people believe that India is burdened with a severe labour surplus and that there are far too many draft animals for the cultivation of available farmland. The argument commonly based on these two suppositions then draws attention to the small size of the *average* Indian farm holding and finishes by assuming that all these *obvious* disadvantages make the use of tractors and farm machinery impossible.

Above all, there is a fear (especially in India) that farm mechanisation will precipitate widespread rural unemployment. Nevertheless, all agree that increased food production is fundamental to India's economic salvation. Such lay considerations of the position usually ends (even in high places) with pleas to the farmer to work harder and to produce more, while at the same time preserving the traditional simplicity of his life.

An element of panic, understandably enough, is becoming apparent in these appeals and exhortations to the Indian farmer. Let us therefore examine the facts, which are well documented.

The rural work force

Graph 1 shows the diminishing proportion of the Indian population, in comparison with the total, that remains in the rural areas from year to year. This trend has been evident since 1921. 'Data for recent decades suggests that the (Indian) urban population has tended to grow more than twice as fast as the general population', according to Coale and Hoover. [2]

The overall aim of the Indian Five Year Plans is to produce just such an increase in urbanisation. 'Another important objective to be attained by the end of the Fifth Plan was the reduction of the proportion of the population dependent on agriculture . . . to about 60%'.[3] Graph 2 shows a rural population curve calculated from Graph 1 and plotted against an estimated total population curve up to 1971.

In the Census years for which figures are available, the Indian rural work force has amounted to very nearly 35% of the rural population. Graph 3 therefore shows, plotted upon food grain achievement and target curves, a curve for the anticipated rural work force to 1971.

This graph emphasises dramatically

Table 1
Bovine livestock in India, 1951*
(*millions of head*)

Livestock classification	*Cattle*	*Buffaloes*	*Total*
Adult work-stock:			
Males ..	58.4	6.0	64.4
Females..	2.3	0.5	2.8
Total ..	60.7	6.5	67.2
Breeding stock:			
Males ..	0.6	0.3	0.9
Females..	46.3	21.0	67.3
Total ..	46.9	21.3	68.2
Young stock	47.4	15.5	62.9
Total of all classes ..	155.1	43.3	198.4

* Source: Second Five-Year Plan, pp. 281-2: Based on Livestock Census of 1951.

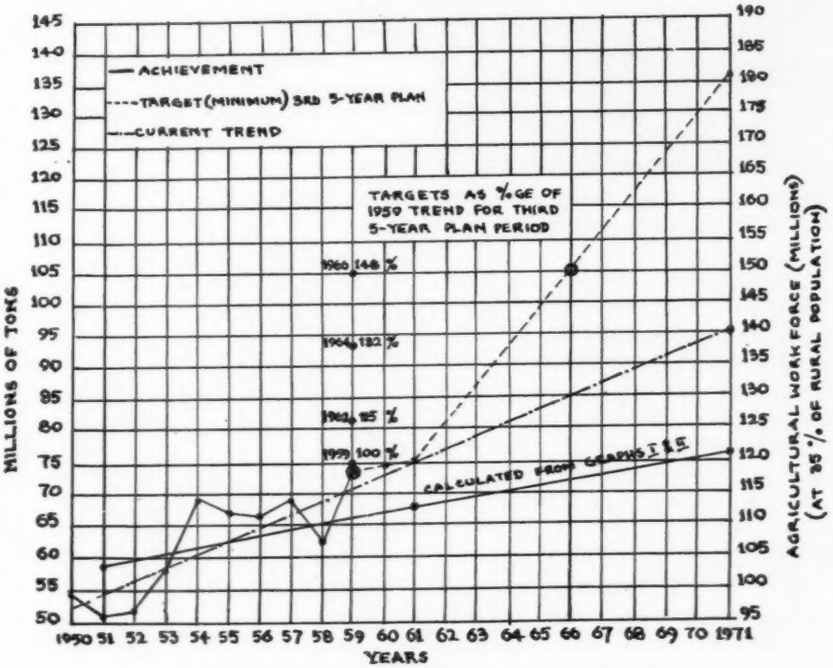
the new 'target' element that has been injected into the Indian farm productivity situation. The general application of improved farming practices can account for a proportion of the gap between 'trend' and 'target' which must be bridged by the dwindling Indian work force.

However, this gap, if it is to be closed, demands food production increases of the order of 50% by 1966—this, with a farm work force that will increase by no more than 5·5%. It is clear that the load on Indian farming is already crippling and that it must increase with each decade, *for it will have to be supported by a farm work force steadily diminishing in relation to targets, if not eventually in actual numbers.*

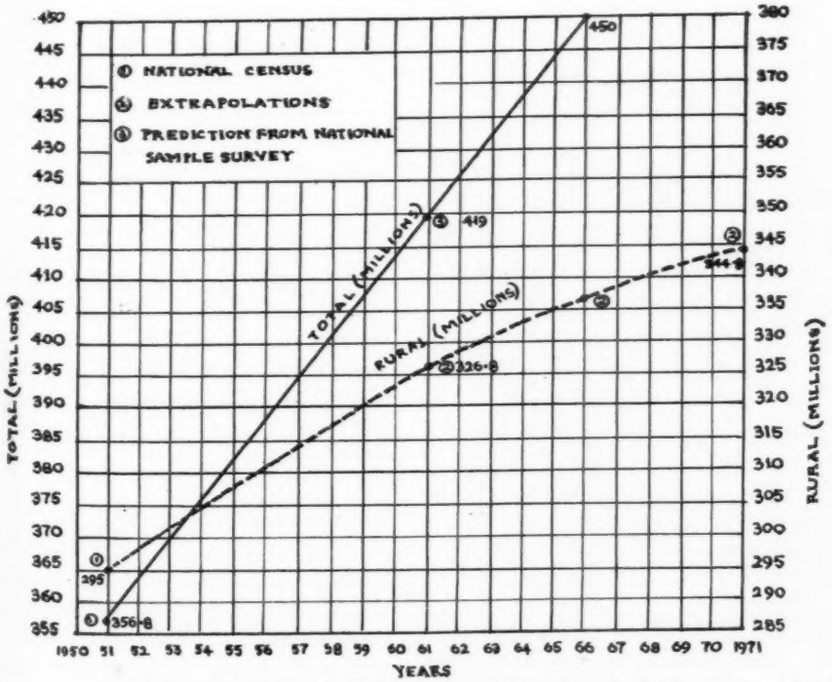
Erratic employment

The Indian work force is generally considered to be largely unemployed. The real problem, however, is under-employment of existing labour. 'Enquiries conducted by the (Indian) National Sample Survey have shown very little sign of visible unemployment in rural areas. There is, of course, widespread under - employment: 'persons engaged in agriculture and in associated activities have productive work only during the appropriate season'.[4] This is no more than a description of a universal characteristic of agricultural employment.

In this respect India does not differ greatly from any other country in the world as far as potential idleness during non-peak cultivating and working periods is concerned. *The significance of the National Sample Survey statement lies in the revelation that during peak work periods the present work force is fully employed.* It is precisely with the aim of freeing labour from peak obligations, and thus permitting year-round commitments of other kinds, that farmers in developed countries have come to rely principally on tractors and farm machinery. Similar advantages are clearly obtainable in India, where *labour absorption at peak times now constitutes a limiting factor to overall production increases.*


ACHIEVEMENT
TARGET (MINIMUM) 3RD 5-YEAR PLAN
CURRENT TREND
TARGETS AS % GE OF 1950 TREND FOR THIRD 5-YEAR PLAN PERIOD
1960 148 %
1964 132 %
1962 115 %
1979 100 %
CALCULATED FROM GRAPHS I & II
MILLIONS OF TONS
AGRICULTURAL WORK FORCE (MILLIONS) (AT 35 % OF RURAL POPULATION)
YEARS

Graph 3. Production of Food Grains in India



Graph 2. Growth of Total and Rural Populations

Farm work stock and livestock

Having considered the decreasing rate of supply of manual labour likely to be available for the achievement of Indian farm production targets it must be remembered that some form of draft power is essential for all but the most primitive kind of subsistence farming.

Table 1 shows that the adult bovine work stock (considered to have remained steady since the Census) is 67.2 millions out of a total of 198.4 millions. There is no need to elaborate on the poor condition from various causes of the majority of Indian bovines. The pressing need to reduce the bovine population has been widely recognised, even by those who would prevent such a reduction for religious reasons.

It is seldom realised, however, that *the work stock is insufficient for the proper cultivation of Indian farmland at the appropriate time each year.*

Manually-operated water lifter commonly seen in India

'Draft power (in India) is barely sufficient for farming on the present scale by present methods. In some regions there is said to be a surplus of draft power, but elsewhere crop yields are known to suffer frequently from insufficient animal power for thorough and timely working of the fields at times of seasonal peak activity'.[5]

A brief reflection on the work stock load each year is illuminating. Out of the total work stock available, perhaps 30 million pairs of animals are fit for work, but not very fit, for the peak work period comes directly after the summer, when fodder is so scarce that mere survival is a critical problem. In other words, *the heaviest work must be accomplished when the animals are in the worst condition.* Primitive ploughs (and even improved ones) make four and five cultivations essential before crops can be sown. An average daily accomplishment might be 0.4 of an acre—never more—and this leads to the following calculation:

$$\frac{\text{320 million acres}}{\text{30 million pairs}} \times 0.4 \text{ acres per day} \times 5 \text{ cultivations} = 132 \text{ days' work per pair per annum.}$$

The sketchiest acquaintance with tropical agriculture and its dependence on 'timeliness' will confirm that *this is an impossible time schedule for effective and intensive cultivation.*

Any additions to the Indian work stock force would intensify a deadly pressure on the land, as a result of which *bovines already compete lethally with the human population for food.* Clearly such increases *must* be prevented; equally clearly also farm mechanisation *must* fill the existing draft power gap—a gap that can only widen far more rapidly in the face of Third Plan production targets.

Size of farm holdings

The average operational farm holding in India is indeed small. It is, in fact, no more than 5.1 acres. Table 2 shows clearly enough, however, that this is most misleading.

What must surely be an inadequate appreciation of these data has resulted in the Indian Government adopting a policy intended to produce a 'ceiling' on land holdings throughout the country. The proposed 'ceiling' varies in different states, but is generally tied to assessments of farm income expectations of a marginal nature. In practical terms, it lies between 20 and 30 acres of good land per holding. The land accruing from the resulting expropriation is to be sold, on long-term repayment, to the landless (in parcels of 2 or 3 acres) and to those currently possessing less than 2 acres.

Notwithstanding considerable activity along these lines, the Indian Planning Commission has recently agreed that very few effective changes have taken place in the pattern of land holding. The Third Plan draft is (perhaps deliberately) vague about this.

These four men are tugging a load of 1¾ tons from Madras to Poonamallee, a distance of 13 miles. They earned Rs. 20s. (£1) from this work and reached Poonamallee 4½ hours after setting out from Madras at 5 a.m. This is a high rate compared with Rs. 13s. charged for rapid transportation by lorry. Clearly India still lacks transportation facilities when hand-carts can command such fees

Table 2
Pattern of operational land holding in rural India

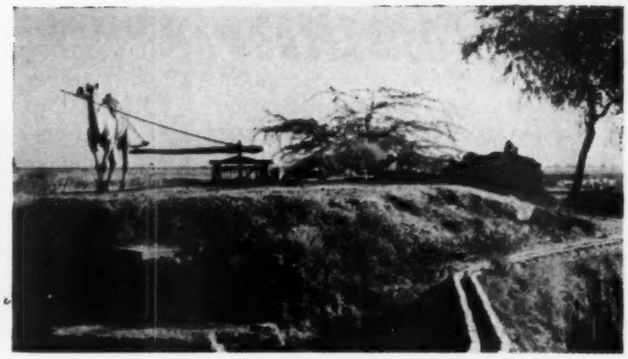
(*July* 1954-*March* 1955)

Size of holdings (acres)	*Percentage of rural households (65 million households)*	*Percentage of total area operated (310 million acres)*
Nil	6.3	Nil
0.01-2.49 ..	48.5	5.9
2.50-4.99 ..	15.9	10.9
5.00-7.49 ..	9.3	10.5
7.50-9.99 ..	5.6	9.1
10.00-14.99 ..	5.5	12.6
15.00-24.99 ..	4.9	17.7
25.00 and above	4.0	33.3
	100.0	100.0

'The first . . . specific object (of) . . . land reform programmes . . . is to remove *such* impediments to agricultural production as arise from the rural structure inherited from the past. This *should* help to create conditions for evolving, as speedily as possible, an agricultural economy with high levels of efficiency and productivity'.[6] [The italics for key words are by the present writer.—Ed.]

Fragmentation inefficient

To the extent that land reform will redress the wrongs suffered by the share-cropping tenants of absentee landlords it is overdue. As a means of supposedly increasing food production through the application of a ceiling,



Left: *This picture shows the usual poor condition of the working cattle in India.* Right: *In the drier regions even the camel is pressed into service as a source of power for irrigation. Here an endless chain of primitive buckets dip into a well 40 ft. deep in order to send a trickle of water over the parched lands*

it must work directly against the fundamental interests of the country as a whole.

It is difficult to pass effective judgment on the political desirability of that part of Indian land reform which might result in land expropriation as a prelude to the imposition of ceilings. If a good political case can be made out for such action, then an example must be recognised of conflict between economic and political goals which could occur in any under-developed country. The predicament facing India's economic planners, who make no reference whatsoever to the burning national question of land ceilings in the Third Plan draft, is one that should clearly be avoided in other parts of the world.

For various reasons, not the least being a system of inheritance which ignores primogeniture,† very severe fragmentation obstructs efficient production on more than half of India's farms. 33.3% of the total area considered in Table 2, amounting to 102.2 million acres, is, however, in holdings of a size to permit immediate efficient capitalisation, especially for the individual purchase and use of farm tractors of various horse-powers.

Tractor potential

If it can be assumed, for instance, that half the number of holdings of 25 acres and above is fit for the use of tractors (from the point of view of investment capacity as well as land suitability) at the rate of one tractor per holding, then 1.3 million tractors could be immediately applied. Their use would go a very long way towards making good the shortages in manual labour and work stock numbers already established. The calculation is as follows: 65 million households $\times \frac{4\%}{100} \times \frac{1}{2} = 1.3$ million tractors.

In all probability the tremendous increase in food grain production required to meet the Indian Third Plan targets will then be achieved, irrespective of the activities of those 64.4% of all farmers whose holdings are smaller than 5 acres. Economic production of surpluses above family requirements is theoretically possible on holdings of such a small size. It is unlikely to be achieved, however, before the impact of improved farming has percolated down through those larger holdings which are immediately suitable for improvement.

With minor qualifications, the same situation holds good for all the under-developed countries of the world. *Indian national survival demands that priorities are given to those who farm large holdings.* It may even be necessary in India and elsewhere to postpone for many years relief measures for small farmers or for the landless, if economic goals are to be secured.

(*To be continued*)

† Primogeniture: inheritance to property by the eldest son.

REFERENCES

1. Boulding, K. E.: 'Principles of Economic Policy', Staples, 1959, p. 336.
2. Coale and Hoover: 'Population Growth and Economic Development in Low Income Countries', Princeton, 1958, p. 137.
3. *Third Five-Year Plan*: Publications Division, Govt. of India, p. 84.
4. *Third Five-Year Plan*: *op. cit.*, p. 84.
5. Coale and Hoover: *op. cit.*, p. 92.
6. *Third Five-Year Plan*: *op. cit.*, p. 93.

More power (as B.Th.U.s) is generated in India through the burning of valuable cattle dung made into flat cakes than in all other ways combined. The possibility that restriction of the bovine population would in time reduce the dung-cake potential of a land with scanty forest resources represents a powerful popular argument against this proposal

Fertilisers and Food Production

2—How Food Production has been Multiplied in Certain Countries

H. L. RICHARDSON,* D.I.C., M.SC.,PH.D.

The examples given in Part 1 illustrate the food potential of the less-developed countries and they indicate that, although the results vary with different regions and crops, yet large and progressive yield increases could be achieved.

IN order to have an independent check on the assumptions previously made and the conclusions reached it is necessary to examine what fertilisers, along with other scientific improvements, have actually done to raise crop yields in several countries that have modern, intensive types of agriculture.

Wheat in England

The average yields of wheat per acre in England since early mediæval times are shown in Table 1. Here yields originally expressed as bushels per acre are converted into lb. per acre for ease of comparison, because a bushel of wheat, for example, weighs much more than a bushel of paddy (rice in the husk).

Table 1
Improvement in yields of wheat in England since A.D. 1250
(lb. per acre)

1250	380
1350	500
1550	940
1750	1,260
1850	1,640
1900	1,890
1950	2,350
1959	3,200

West African farmer and his fertilised maize crop

The low yields of the 13th and 14th centuries were those of the mediæval open-field system and are comparable with the yields obtained by the most primitive methods of shifting cultivation in under-developed countries today. By the 16th century there had already been some improvement in cultural methods, and perhaps more use was made of farm manure; the yields of wheat then being obtained in England were rather higher than the average wheat yields in India, Pakistan or mainland China in recent years.

With the coming of the enclosures† better crop rotations and other improvements, yields continued to rise in England during the 18th and 19th centuries. The figure for 1850, of over 1,600 lb. per acre, shows what could be obtained by good traditional farming methods, including the use of farmyard manure, but practically no chemical fertilisers.

Since the mid-19th century, with the gradual introduction of modern scientific methods, including the use of fertilisers, British wheat yields have continued to rise. In 1950 the yield was nearly 50% above 1850, and in 1959 it was 95% above 1850; in other words, the yields obtained by good traditional farming methods have almost been doubled.

There can be no doubt that a large part of this increase, especially in recent years, has come from the increasingly heavy use of chemical fertilisers along with the use of new varieties of wheat that resist lodging and disease. It would seem reasonable

* Imperial Chemical Industries Ltd.

† Enclosures: the fencing in of waste or common land by the lord of the manor and the building up of smaller holdings into enclosed farms.

Paddy harvest in Japan: Japonica-type rice, short stemmed but heavy yielding when heavily fertilised. Soya beans on bund

to attribute at least 50% of the increase over the 1850 yields to the direct effect of fertilisers. Responses of this order are still commonly observed in fertiliser experiments with cereals in Britain.

English farmers have some way yet to go before they reach optimum levels of fertiliser use on cereals, so that the traditional yields of 1850 will be considerably more than doubled before the process is finished. Even today the yield of wheat in Britain is between three and four times what it was in Elizabethan England (16th century) and many times greater than in the early Middle Ages (9th–14th centuries).

Rice in Japan

The average yields of paddy in Japan over the centuries are shown in Table 2.

The story of rice yields in Japan is similar to that for wheat in England, except that throughout the period the yields of rice have been at a higher level in lb. of grain per acre. This is partly because, unlike wheat, rice grown in flooded fields usually has an assured water supply and partly because rice fields have their own sources of soil fertility in mud brought in by irrigation water and in nitrogen-fixing micro-organisms. The early mediæval rice yield in Japan was similar to the average yield in India today.

It is striking that, as with wheat in England, the rice yield in Japan in mediæval times was just about doubled by the second half of the 19th century as a result of improving the early cultural methods and using local manures. With the introduction of chemical fertilisers into Japan, along with improvements in cultural methods and in varieties, the increase in average yields continued and, as a result, rice yields have very nearly doubled again.

As with wheat in England, so with rice in Japan it would be reasonable to assume that at least half of this doubling of yields formerly obtained by traditional methods is the direct response to fertilisers. Still higher yields can be expected as a result of research work now in progress in Japan, combined with still heavier applications of fertilisers.

Table 2
Improvement in yields of paddy in Japan since the 8th century
(lb. per acre)

8th century	1,130
16th century	1,690
1883-87	2,190
1898-1902	2,540
1918-22	3,200
1938-42	3,380
1948-52	3,570
1959	4,240

Rice in Formosa (Taiwan)

In Formosa, agricultural improvement began within living memory, so that we have almost under our eyes a picture of how a traditional type of Asian peasant agriculture can be developed by modern methods. The average yields of paddy rice are shown in Table 3.

The rice yield in Formosa early in

Table 3
Improvement in yields of paddy in Formosa since 1910
(lb. per acre)

1910-11	1,555
1920-21	1,632
1934-38	2,195
1946	1,677
1950-51	2,168
1959	2,650

Transplanting paddy seedlings in Malaya. Half-grown rice in middle distance, mature crop at back

the present century, with traditional farming methods that included the use of local manures, was similar to that in Japan in the 16th century, and through technical improvements, including fertiliser use, it was raised by an average of about 40% in the years before the war. By the end of the war, as the result of an almost complete lack of fertilisers, the rice yield fell back nearly to where it had started from—which shows how great a part fertilisers had played in securing the pre-war 40% increase—and since then, with increased usage of chemical fertilisers and other improvements, the yield has been raised well above the pre-war levels.

By 1959 the average rice yield per acre had been increased by almost 75% above the unimproved yield at the beginning of the century, and the extent of the war-time fall, when fertilisers were lacking, suggests that over half of this increase, or something approaching 50% of the original unimproved yield, can be attributed as the direct response to fertilisers.

The average yield of rice in Formosa is still well below that in Japan, although fertiliser use is at least as heavy. This is probably because two, or even three, rice crops a year are grown in most parts of Formosa. Consequently short-period varieties that do not have time to produce extremely heavy yields are used. If we take the output of rice per acre per year instead of per crop, then Formosa is already ahead of Japan; on double-cropped land the annual output would average some 5,300 lb. per acre, as against 4,300 lb. in Japan.

The fertiliser potential

In spite of the variability of the results with different crops and in different countries, it is fair to say that on the whole the direct response to chemical fertilisers, used at low to moderate rates in less developed countries, varies around 50% of the unfertilised yield; and that the combined response to fertilisers and other methods of improvement going on simultaneously averages around 100%. In other words, the present production of food crops in the less developed countries could be doubled by using moderate fertiliser treatments and other techniques that could and should be put into effect without delay.

How much further the improvement in yields could go depends on such matters as the present fertility of a country's soils and whether, or not, irrigation is available in dry climates. On the more fertile soils, such as those in China, where crop yields are already moderately high, doubling the original yields would be about the limit that could reasonably be expected from the techniques now available. On the less fertile soils, such as those in India, tropical Africa and America, the full application of modern intensive methods, including heavier fertiliser dressings and suitable new varieties, could not only double the original yields, but double them again in many places, or at least add another 50%.

Thus in the long run the production of food crops from the present areas might be multiplied three or four times. Extension of the agricultural areas, or of the irrigated areas, would still further enlarge the fertiliser potential; irrigation, in particular, along with other agricultural improvements, makes possible remarkable responses to heavy fertiliser dressings.

These broad conclusions are confirmed by what has actually been done in countries like England and Japan, where the low medieval yields of food crops were approximately doubled by improving the farming methods along the traditional lines, including local manures, and then doubled again by introducing the techniques of modern intensive agriculture. About 50% of this last increase is to be attributed to the direct effects of chemical fertilisers.

This possibility has been stressed by Dr. H. Greene, of Rothamsted, who has pointed out that in under-developed countries the maximum yields obtained in fertiliser experiments at agricultural research stations are often three or four times the yields that the peasant cultivators around the station are getting.

The experimental results given earlier and the above discussions have all related to the principal food crops, and it is thus reasonable to assume that food production as a whole in most of the less developed countries—the ones with the severest population problems—could be doubled and eventually trebled, or even quadrupled, by using fertilisers and other modern agricultural methods.

Obstacles to progress

The speed at which this can be done depends very much on the countries themselves. Although more field experimental work will be needed in individual countries to ensure that fertilisers are used with full efficiency, and numerous field trials will be wanted for demonstration purposes, we know enough to make a start. Other experimental work, varietal improvement and so on can be proceeding at the same time as the agricultural development. The real limitations to rapid increases in domestic food production are social, financial and educational rather than technical. In particular, the less developed countries will have greatly to increase their farm

(*Continued on page* 102)

A fertiliser store in the Far East: farmers equipped with various simple kinds of transport are awaiting their turn

The Johnson potato harvester (left) *and the John Salmon potato harvester* (right) *delivering potatoes by cleaning conveyor and elevator into an accompanying trailer*

Tuber Damage by Man and Machine

W. H. CASHMORE,* C.B.E., B.A., N.D.A.

Potato damage is very much in the news, but damage during lifting and transporting is not a new feature. The reason for the present concern is the growing interest in higher quality and the increasing sale of pre-packaged and cleaned potatoes. This also happens to coincide with the introduction of the complete harvester—a machine which is now becoming a necessity because of the shortage of labour—and it is perhaps only natural that machines and mechanisation are given much of the blame for the damage.

IN considering the causes and the prevention of damage it is first of all necessary to define it. The three main classes of injury are as follows:

Scuffed: where only the skin is broken.

Peeler or slight damage: damage which can be removed by using a standard peeler.

Serious damage: damage which remains after peeling and this includes split tubers.

Obviously the various conditions of damage differ in importance. An open wound enables disease organisms to enter the tuber, but the wastage which occurs when the potatoes are prepared for cooking varies considerably: those with deep cuts and 'splits' give more wastage than those which are merely 'scuffed' or superficially damaged.

Damage surveys

In assessing damage, figures mean little unless a true representative sample is taken for examination. The sample is washed and stained in *p*-cresol, which changes the colour of damaged tissue; even the smaller wounds can be detected and new damage can be distinguished from old wounds.

In 1959 the N.I.A.E. co-operated with the Potato Marketing Board and the Ditton Laboratory in a survey of damage in East Anglia. It is not advisable to draw firm conclusions from this single survey because it was far from being an average season and was limited in scope. The overall results indicated that in the field operations, *i.e.* lifting by spinner, elevator digger or harvester, approximately only 33% were undamaged. The damaged portion contained 25% scuffed, 25% slightly damaged and 17% seriously damaged. There was considerable further damage by the time the potatoes reached the store from the field, when the undamaged portion showed a further reduction by 10%, with an increase of 6% in the serious damage class.

A final check at the time of removal from the store showed that most of the scuffed and slightly damaged tubers had healed, except where disease organisms had entered. Nevertheless, allowing for rotting, damage, shrinkage and sprouting, the weight of saleable ware was little over 66% of the weight which went into the store.

It is interesting to compare the figures from this survey with those obtained at the Potato Marketing Board's 1960 harvesting demonstration near Ormskirk, but allowances need to be made for the different

* Paper given by the Director of the N.I.A.E. at the Crop Conference at the National Institute of Agricultural Botany, Cambridge, England, in December 1960.

district and the very different working conditions. At this demonstration the hand-picking control post showed 21.6% were undamaged, 58.8% were scuffed, 10.1% were slightly damaged and 9.5% were seriously damaged.

The best performance by a machine was 20% undamaged, 56% scuffed, 9.1% slightly damaged and 14.9% seriously damaged.

The worst performance by a machine was 5.3% undamaged, 67.4% scuffed, 13.7% slightly damaged and 18.6% seriously damaged.

A damage index

It has been found by weighing the spoilage that the three classes—scuffed, slight damage and severe damage — had a wastage ratio of 1 : 3 : 7. A comparative damage index figure can be obtained by multiplying the percentage obtained in each class by the appropriate factor.

Using this index, the field damage was as follows:

P.M.B. 1959 survey, above	219
Hand picking at demonstration	156
Best machine performance	188
Worst machine performance	239

The damage figures at the demonstration appear to be high because of considerable scuffing. It may be that undue prominence is being paid to scuffing because slight skinning usually heals during storage, and in most cases 60-70% of the tubers are scuffed by the time they reach the housewife.

Factors causing damage

The modern harvester, properly handled, does not leave much scope for improvement, but the need for proper supervision cannot be overemphasised. Careful handling of an indifferent machine can give less damage than the best machine without proper supervision.

Field conditions also have a considerable effect on the extent of damage. The N.I.A.E. Scottish Station found that a power-driven spinner had a 75% higher damage index on a dry gravel soil than with dry medium loam. It also showed that the damage with spinners was higher than with elevator diggers, possibly because the elevator digger had more adjustments to suit various conditions. With all machines it is important to set the share deep enough to avoid slicing the tubers and when the haulm cutters are used care should be taken to prevent the cutters hitting the top of the ridge.

Most research on the prevention of damage has been with the chain elevator digger, the essential feature of which is a series of rods or chain links hooked together to form a conveyor and soil separator. In certain conditions the hooks at the ends of the rods can gouge holes in the tubers. The soil falls through the rods as they convey the potatoes, but such agitation should always be as gentle as the conditions will allow. Experimental work by the Canadian Department of Agriculture has shown that excessive agitation can increase the damage by as much as seven times.

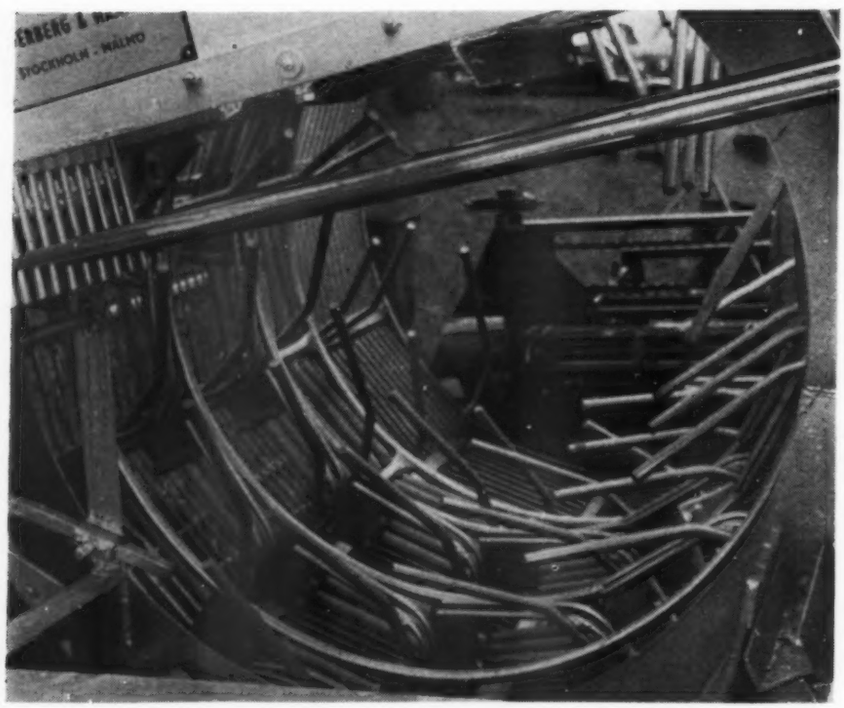
Photos: N.I.A.E.

Damage to potatoes is not a new feature. Potatoes should not be walked over if damage is to be avoided

The factor needing most attention in the operation of elevator diggers is the speed of the elevator. The ratio of forward speed to elevator speed determines the point at which most of the soil is removed. When little soil is present the action of the elevator causes skinning because there is no cushioning effect.

Experimental work carried out in North Dakota with 47 elevator diggers having elevator speeds varying from 180-360 ft. per min. showed that the optimum range from the point of view of damage was 220-240 ft. per min. The usual recommendation for the ratio of elevator speed to forward speed is 1.1 : 1.0, and experimental work carried out in Canada has shown that minimum injury occurred between ratios of 0.7 : 1.0 and 1.0 : 1.0, according to soil conditions.

If the elevator speed is limited to 230 ft. per min., then the maximum forward travel is 2.6 m.p.h. It is important to observe this in the case of elevator diggers, but there is little risk of exceeding 2.6 m.p.h. in the case of complete harvesters because operators could not keep the machine clear at those speeds.



A Swedish potato harvester, showing the rods in the cleaner conveyor

Modern tractors offer ample facilities and gears for adjusting the forward speed to elevator speed, but some skill and knowledge is necessary; for instance, working in first gear at full throttle could easily result in soil separation at too early a stage and better results would be obtained in second gear at a slightly lower engine speed.

Hand lifting often gives more bruising than mechanical devices, for the careless use of a worn-out graip can cause damage

Experimental work has been carried out in Sweden on covering the chain links with rubber so as to reduce the damage, and the results showed that it had a beneficial effect, but perhaps not so much as might have been expected. N.I.A.E. work with rubber-covered links showed that it reduces the damage from direct blows, but does little to prevent damage from a glancing blow. There does not seem to be a strong case for having rubber-covered links on the standard elevator digger, but it is beneficial on chain conveyors working in the final stages of a complete harvester.

Much of the scuffing damage is caused by tubers rubbing against clods or stones during the lifting process. Little can be done to avoid this, but obviously harvesters with revolving-drum cleaners should not be selected for farms where clods and stones are prevalent.

Damage from hand lifting

The figures from the survey indicated that there is a considerable increase in serious damage between the time of lifting and placing in storage. This damage is not confined to the complete harvesters, for hand lifting sometimes gives more bruising than mechanical devices. A hand-picking gang may use bags or baskets which are thrown up to a man actually standing in the trailer, or they may be thrown into a trailer by men walking alongside. This technique can cause considerable damage in the form of bruising and splitting.

An N.I.A.E. Scottish Station investigation showed that considerable damage could result from undue carelessness with the barrel system. The damage index before gathering was 105. The potatoes were picked into baskets and then emptied into 40-gal. barrels, when it was found that the potatoes at the bottom of the barrel had a damage index of 194, compared with 155 at the top. The barrels were lifted and tipped into carts by a tractor fore-loader and the potatoes were then tipped from the carts into an indoor store and hand loaded to a height of about 5 ft. 6 in. Further damage occurred at each stage, but it is interesting to note that a fore-loader can be used to spill rather than tip the containers and so keep damage to a minimum.

A hand-picking gang often uses bags or baskets which are thrown into the trailer This operation should be done gently

Mechanical harvesting damage

With complete harvesters damage takes place when the potatoes fall into the trailer. Experimental work at the N.I.A.E. has shown that large potatoes are more easily damaged than small ones; for instance, a fall of only 6 in. on to a wooden floor may cause a large potato to split. The incidence of damage is much less when dropped on to a layer of potatoes. Although large potatoes can be dropped 9 ft. on to a canvas sling, a heavy rubberised canvas laid on a wooden floor is only a very slight improvement on plain wood. Obviously the height of the delivery elevator of a harvester must be made adjustable so that the drop can always be kept at a minimum.

The present system of handling from the field to the store leaves much to be desired. There is a strong case for loading the potatoes into 5-10-cwt. pallets on the harvester and then collecting the pallets by tractor fore-loader. The pallets can then either be tipped into the store or used to hold the potatoes in the store until taken out for grading.

The success of this technique will depend on the cost of the pallets, but it is assumed that they would be built on the farm and their cost might easily be offset by the increase in the percentage of saleable potatoes. Further damage occurs when the potatoes are sorted, but it need be little more than superficial scuffing if care is taken. Hand riddling gives two or three times as much damage as a machine grader, and the rubber spool-type machine gives less damage than those with reciprocating metal ridges. The latter cause less damage if used with rubber-covered riddles.

One of the commonest causes of damage during sorting is the throwing of the potatoes from the store or pit to the machine; keeping the sorter close to the open face of the hopper reduces this risk.

From the evidence obtained there is little prospect of any appreciable reduction in damage by further improvements in harvester design, but every effort should be made and no

Hand riddling gives two or three times as much damage as machine grading. The shape of the potatoes is a factor in this

doubt this will be stimulated by the Potato Marketing Board's harvesting demonstrations, at which damage by the various harvesters was recorded.

Cultivation and clods

Regarding cultivations, it is necessary to use mechanical planters which plant at a regular depth with little deviation from the central line so that the lifting share can be set without the risk of slicing potatoes. Clods cause trouble with harvesters because they hinder the operators and slow down the rate of working and are a source of damage through rubbing the potatoes. Some of the clods going into the harvester have remained from the time of planting, but many more have been formed by pneumatic-tyred tractors running through the crop in various pre-harvesting operations.

At the present time all that can be done is to produce a good tilth before the time of planting and avoid any unnecessary tractor work afterwards, especially when the soil is damp. Pre-emergence spraying for weed control and improved implements for earthing up the rows could further reduce clod formation.

Varietal resistance to injury

Work in Germany has shown that potatoes have clear differences in their resistance to injury, depending on climate, soil types, soil conditions, state of maturity and variety. This has been confirmed by N.I.A.E. work; in an examination of the effect of maturity it was shown that 'Kerrs Pink', harvested at the end of August, had a damage index double that of the same crop harvested at the end of October. The explanation is probably that skin thickness increases with maturity. In another experiment, at the time of lifting, 'Arran Pilot' had a damage index of 132, compared with 90 for 'Golden Wonder'. Another variety, 'Record', has a particularly tough skin and seems to suffer far less scuffing than most varieties. It is interesting to note that ware-sized potatoes have a damage index about double that for seed potatoes.

Dr. Lampe in Germany has developed an instrument for measuring the toughness of the skin of the potato and one of these instruments has been delivered to the N.I.A.E. It may help in the investigations into the causes of damage and the susceptibility of different varieties. One of the greatest troubles at the moment is scuffing. If the plant breeder could find a variety with the required quality with a tougher skin it would be of enormous importance to the potato industry.

One of the commonest causes of damage comes from the throwing of potatoes into the hopper of a potato grader

The shape of potatoes is another factor in susceptibility to damage. On average, round potatoes suffer more damage than oval-shaped ones. This is because the round potatoes roll down the elevator web and take longer to pass up the elevator; on the other hand, long potatoes are more vulnerable at their ends.

In conclusion, it is evident that there is need for great improvement in the reduction of damage to potatoes. It is an economic problem which has got to be solved. Even allowing for the possibility of finding ways of marketing the rejects, the future of the potato crop is insecure unless the overall damage can be reduced. There is every reason to think that the necessary improvement will be achieved, but it will come about by the combined effort of agricultural engineers, plant breeders, crop husbandry experts and the growers.

Fertiliser Use in Pakistan

Increased agricultural production in Pakistan faces two main obstacles, according to Dr. George Vermaat, the Dutch specialist in soil fertility, who has been working for FAO in Pakistan. The first is waterlogged conditions and the increasing salinity of much of the irrigated land; the second is more easily corrected—the inadequate supply of nutrients in the soil, pests and fungus diseases.

Since 1957 FAO has been conducting a rapid soil fertility survey for the Pakistan Government, together with a scheme for popularising the use of fertilisers. About 4,000 experiments have been carried out, using fertilisers on farmers' holdings selected at random and so demonstrating the increased yield possible, often double.

From the experiments in East Pakistan it is believed that paddy output could be stepped up from the present 12 million tons simply by fertiliser applications. After meeting the cost of the fertiliser there is still a substantial profit left for the farmer. The results also indicate that many paddy soils lack not only nitrogen, but also phosphates, and the use of specific fertilisers for particular conditions is now being officially recommended in Pakistan.

Further expansion of this scheme is now planned. The East Pakistan Government proposes to extend the tests fivefold, using a staff of nearly 500 technicians. Improved varieties of seeds are also being planted and varietal trials are being carried out in addition.

By-products of the Rice Industry

D. H. GRIST

Rice is the world's leading cereal crop, yet its by-products are scarcely used. These could provide an important source of additional food and raw materials.

LARGE quantities of straw, hulls, broken rice and bran—the chief by-products of the rice industry—are used to support livestock in most rice-producing countries. For instance, some years ago it was estimated that in China 46% of the straw produced in that country was used for this purpose, while 32% was used for fuel and 11% in industry. Traditionally the straw is utilised in village industries. Research during the past few years has extended the uses for rice by-products and a number of these possibilities merit careful consideration.

In milling and polishing rice the following products are obtained: rice 48%, points and broken rice 16%, bran 13%, meal 3% and husk 20%. These figures will vary according to variety of paddy, its age and moisture content, and on the degree of milling and polishing to which it is subjected.

Rice straw

Rice straw is used in Asia for roofing, clothing, ropes, footwear, mats, sacks, paper, fuel and compost. In Japan alone rice straw is the basic material for rural industries supporting 10 million people. The annual production of plaited bags in Korea is said to be about 22 million. Although the Philippines produce large quantities of rice, the country imports special quality rice straw for hat making. In China, Burma and Malaya the mushroom, *Volvaria diplosia*, is cultivated on beds of paddy straw. These examples illustrate the extreme importance of rice straw in the internal economy of many Eastern nations.

The straw produced with a ton of paddy contains about 20 lb. nitrogen, 2½ lb. phosphoric acid and 30 lb. potash. It is evident, therefore, that its removal from the field depletes the soil of considerable quantities of plant food. There is evidence that fertilising with fresh straw has a harmful effect on young rice plants. However, rice straw decomposes rapidly in the soil, so that if it is incorporated into the soil some time before the next crop is planted it will have a beneficial effect.

Where the crop is harvested ear by ear, as in many Asian countries, or is combine-harvested, as in Australia and the U.S.A., the straw is left on the land to provide a certain amount of fodder and ultimately is ploughed under. In some regions rice straw is removed from the field and stacked to provide forage and bedding for cattle.

The digestible nutrients of rice straw are about 1% proteins, 0.5% fats and 30% carbohydrates. Although it is a useful roughage for cattle, its digestibility is inferior to that of other

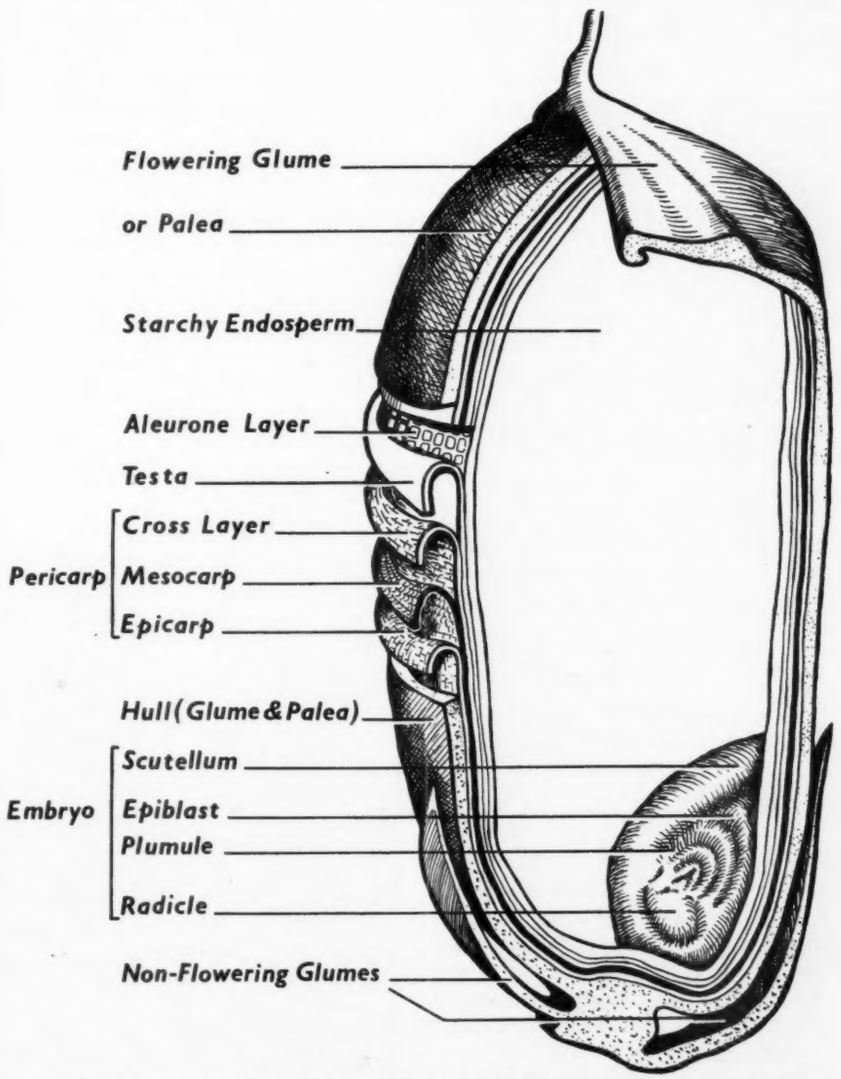


Illustration reproduced from 'Rice' by D. H. Grist, published by Longmans, Green & Co. Ltd.

Grain of rice—the husk comes from the glumes; the aleurone produces bran, which also includes the embryo if the rice is over-polished

Harvesting rice with a tupai or rice cutter —one head at a time

cereal straws, but supplemented with concentrates it can be fed to milch cows and bullocks in quantities up to half the total daily ration.

Ensilage offers an alternative method of preparation for consumption. The straw is stacked in the open and under considerable pressure for several months. It assumes a brown colour and pleasant odour and is readily consumed by cattle. Its analysis is said to be: proteins 4.8%, fats 2.2%, non-nitrogenous extracts 25.6%.

An industry has developed in Korea for production of building board made from rice straw and sodium silicate, both of which are produced in that country. The board can be worked like wood, is light and strong, resistant to vermin and moisture, and has insulating and sound-proofing qualities.

Rice straw has for centuries past been used in Asia for the manufacture of paper. A more modern process of treating straw, developed in India, gave 8 cwt. of paper pulp per ton of straw. It is said to yield a strong, opaque paper of excellent quality. Although reports concerning the suitability of rice straw for paper-making have invariably been favourable, the industry has made no great headway because of the difficulty of obtaining adequate and regular supplies.

There are many references in literature to the production of alcohol from the straw. It would appear that, heated with sulphuric acid, neutralised and fermented with distillery yeast, it yields over 5% alcohol. Very few distilleries use rice straw for this purpose, probably because other raw materials give higher yields and present no problems regarding regular and adequate supplies.

Rice hulls

The hulls are valueless as food, not only because of their low nutritive value, but also because they contain about 18% of silica, which renders them harmful to the digestive and respiratory organs of animals. The hulls contain 2.5% protein, 35% soluble carbohydrates and 0.5% fats.

Their fuel value being 5,000-6,000 B.Th.U. per lb., they are suitable for producing the power needed to operate the rice mill. Mills produce more than enough hulls for all their fuel requirements. About 80% are so used, leaving a surplus of 20%, the disposal of which may be difficult or costly. In recent years, however, a number of new uses have been found for the hulls.

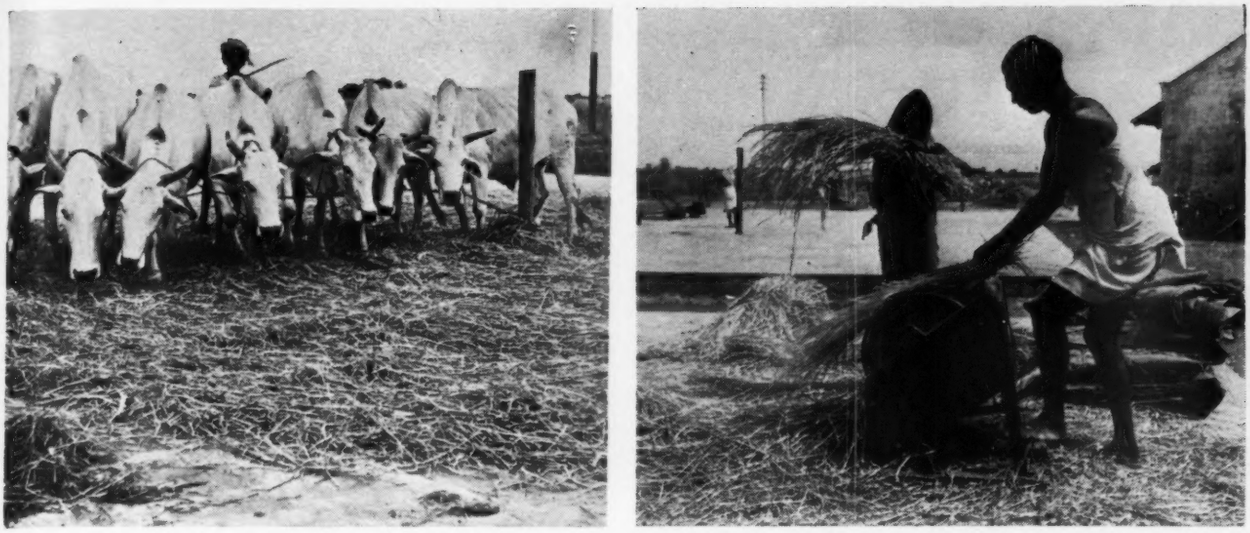
Pressed insulating board, a high-quality cement tile and a cement breeze brick block may be made from the hulls. Soil ash bricks are made from a mixture of soil and rice hull ash, emulsified asphalt being added as a soil stabiliser. The bricks are said to be light and provide a high degree of insulation. This product has attracted interest because of the claim that it can absorb atomic radiation.

Some success has attended the employment of hulls for cardboard manufacture, but they are of no use in paper-making, as they produce a weak, brittle paper. Hulls are used in the East for packing fragile china. In New Orleans charred hulls have been used as a substitute for bone-black in refining sugar, while in the Philippines a distillate obtained from the incomplete combustion of hulls is used as a home medicine. By reason of its high silica content, hull ash may find application in the glass industry.

Hulls have also been used for the following purposes: stable litter, fertiliser, a supporting medium for growing vegetables hydroponically, an additive when planting grass or other seeds which are mechanically difficult to sow, a soil conditioner, a grease-absorbing sweeping compound, a raw material for refractory insulators and in incubating eggs. An edible, odourless and tasteless cellulose has been manufactured from hulls for use in manufactured breakfast foods. The Ontario Research Foundation report the production on a commercial scale of humidifier plates from rice hulls.

About 19-21% of alcohol may be obtained from hulls; this possibility may be important where wood alcohol and cellulose works are operating in or near rice-growing centres. By dry distillation, hulls give carbon of low density and a liquid which contains *inter alia* acetic acid, furfuraldehyde, phenol and cresols. Furfural is readily obtained by heating hulls in the

A tractor being used for winnowing rice by attaching a fan to the p.t.-o. The grain is thrown in front of the air-blast and the chaff is blown from the grains and collects in a heap (extreme left)



Threshing rice in India (left) *by oxen and* (right) *by means of a pedal thresher*

presence of sulphuric acid under steam pressure. It is employed in the manufacture of synthetic resins and solvents, absorbent detergents, weedkillers, wood preservatives and in the manufacture of nylon.

The abrasive character and high ash content (about 18%, containing 94.5% of finely divided silica) are the outstanding properties of hulls and suggest many possible uses in industry, for there is a very large field for cleaning and polishing agents.

A mixture of 60 parts corn cob and 40 parts rice hulls under an airblast of 90 lb. pressure cleans carbon and dirt from engine pistons and cylinders. Hulls included with other agents have also proved successful in the 'tumbling barrel' method of cleaning and polishing. Ground to pass a 20-mesh and be retained on a 100-mesh screen, hulls are being used in abrasive soaps for use in factories and engineering shops, the amount of abrasive material so incorporated varying from 30-60%.

Broken rice

The amount of broken rice resulting from milling depends mainly on the variety of rice, its age, condition and the amount of milling to which it is subjected. Rice starch is preferred to other starches for many industrial purposes because its particles are very fine, thus increasing its smoothness and adhesive power.

The Chinese use broken rice in the manufacture of rice spirit or 'arak', and the Japanese in making beer. In many parts of Asia broken rice is employed for starching clothing and, ground to a fine powder, as a cosmetic. The possibility of using rice starch in oil-well drilling muds is being investigated in the U.S.A.

Broken rice frequently contains stones, grit and dirt, which are difficult to remove and which therefore limit its value. In India the better grades are used for making flour or semolina and in Italy it is mixed with wheat flour to make bread. It is also suggested as a material for reconstitution into rice-shaped grains.

Rice bran

The bran, which forms about 13% of milled rice, contains 15-20% of oil and 0.4-1.5% of crude wax. It also contains about 5-8% protein, 40-50% soluble carbohydrates and 5-8% fibre. Hitherto the principal use for bran has been as a stock feed, but it is somewhat unsatisfactory for this purpose because it rapidly becomes rancid and unpalatable.

This change commences immediately the bran is separated from the grain, due mainly to the activity of a lipolytic enzyme. For the first few hours after milling its acidity (f.f.a) will increase at the rate of 1% per hour to a total of about 60% within a month. Measures taken to stabilise bran against enzymatic activity have not been entirely successful. Bran from 'converted' and from parboiled rice is relatively stable, but even with these the f.f.a. content of the extracted oil may be 2 or 3%.

It follows, then, that oil extraction must be effected immediately after the milling process. Increase of acidity can be stopped if the bran is put through a heating and drying process at 200°F for an hour and the moisture then reduced to about 3%. Bran thus treated may be stored for about 25 days, but this treatment is not only costly, but also tends to darken the contained oil.

(*To be continued*)

Technical News

Articles in the March issue of some of the other journals of the Leonard Hill Technical Group include the following:

Manufacturing Chemist. — 'The Scent of Flowers and Leaves—3' by E. S. Maurer.

Dairy Engineering. — 'UNICEF Loan for Kenya Dairy' by K. A. J. Hunt.

Fibres & Plastics.—'Plastic-coated Steel'.

Paint Manufacture.—'O.C.C.A. Exhibition Preview'.

Chemical & Process Engineering.—'Materials of Construction for Chemical Plant—Aluminium' by J. C. Bailey.

Specimen copies of the above journals are available on application to Leonard Hill House, Eden Street, London, N.W.1.

Coming Events

Fungicides.—The Pesticides Group of the Society of Chemical Industry will hold a symposium on 'Fungicides in Agriculture and Horticulture' on 20 and 21 March. The fee will be 20*s.* for members of the Society and 50*s.* for non-members. Requests for application forms should be sent to Dr. B. J. Heywood, Hon. Secretary, Pesticides Group, S.C.I., 103 Harrow Drive, Hornchurch, Essex.

Work Study.—A course in agricultural work study has been established at Seale-Hayne Agricultural College. The course, will last for 10 weeks commencing on 10 April and then two 10-week courses will be conducted during each academic year. Details may be obtained from Mr. H. T. Williams, Farm Management Dept., Seale-Hayne Agricultural College, Newton Abbot, Devon, England.

Horticulture.—An International Exhibition of Flowers and Plants is to be held in Turin from 28 April-7 May. Details may be obtained from the Fiori del Mondo a Torino, Esposizione Internazionale, Via Pomba 23, Turin, Italy.

The Chelsea Flower Show will be held at the Royal Hospital, London, from 16-19 *May*, and not March as previously announced. Particulars may be obtained from the Royal Horticultural Society, Vincent Square, London, S.W.1.

Agricultural Exhibitions

Egypt.—The World Agricultural Exhibition to be held in Cairo will take place from 21 March-20 April. Details from the Exhibition Committee, Central Ministry of Agriculture, Cairo.

France.—The International Agricultural Machinery Exhibition will be held in Paris from 7-12 March. Particulars from the Salon International de la Machine Agricole, 95 rue Saint-Lazare, Paris 9e.

Italy.—The International Agricultural and Animal Farming Fair will be held in Verona from 12-20 March. Further details may be obtained from Secretary-General, International Agricultural Fair, Palazzo del Pallone, Verona.

South Africa.—The Rand Easter Show will be held from 21 March-3 April. Enquiries should be sent to the Witwatersrand Agricultural Society, P.O. Box 4344, Johannesburg.

Fertilisers and Food Production—2

(*Continued from page* 94)

advisory or extension services—one advisory officer in the field to every thousand farmers is not enough.

If the government of a less developed country regarded the food problem as grave enough to justify such an expenditure of money and effort as would really get results, then *food production could be doubled within a generation*, which would take care of any conceivable rate of population increase. The process would not stop there, however—in the course of time food production could be doubled again; and by then either better control of population increase or new scientific developments in food production would be exerting their influences.

In this article attention has been focused on what can be done in the under-developed countries, because in these the food and population problems are most serious. Even in the more highly developed countries with their intensive agriculture the increased use of fertilisers and associated improvements can further increase food production. Britain, for example, has increased her agricultural output by 60% since before the war and fertiliser use has been multiplied several times in doing so, yet the possibilities of further crop increases are not exhausted.

In the U.S.A. with important crops like wheat and maize, although their average yields have risen since pre-war, the process of increasing them still has far to go. If there were not crop surpluses the current U.S. yields of these crops could at least be doubled by using more intensive modern methods, including heavier fertiliser dressings.

To increase food production still further in countries that already have a highly intensive agriculture will be the most difficult problem, yet even here there are possibilities that are now being explored in agricultural research.

Even higher yields

Still greater long-term possibilities may be revealed by investigating how it is that the average crop yields obtainable by good intensive methods are so far below the top yields given by certain favoured fields.

Crop competitions and officially observed measurements in many countries—even the less developed ones—have recorded yields from individual fields ranging from about 8,000 to over 12,000 lb. of food grain per acre; say around 5 tons an acre. By contrast, even the highest national average yields for food grains are between 1½ and 2½ tons an acre. It is possible to hazard a guess at some of the reasons that make the favoured fields so fertile, but further investigation is needed; given the power of scientific inference and all the resources of modern technology, it should eventually be possible to produce such yields to order on a large part of the cultivated land.

If as much money and effort were to be devoted to the problems of world food supplies as that spent, for instance, on guided missiles, rocket research and space travel, the answers would soon be found. Perhaps this stage will be reached by the turn of the century if the population explosion has not been brought under control. By then fertilisers may well be considered as important as steel, for example, and required in similar quantities. When it is known and appreciated more widely how to secure top yields it will then be possible to produce many times the present quantities of food.

Preventive Weed Control in Tea

V. F. MEDLEY, B.SC.(HORT.)

The use of chemicals in tea has been limited in the past by the risk of damaging this perennial shrub and adversely affecting the delicate flavour of the processed leaf. The recent discovery of a new group of soil-applied herbicides has brought safe weed control in tea within reach of the grower.

IN Ceylon, tea is cultivated on a limited acreage, but tea-growing areas range from the lowlands, under 100 ft. elevation, to up-country areas, which may be more than 6,000 ft. above sea level, where the slopes may be steep and the soil rocky. Rainfall ranges from 70 in. to over 200 in. per annum and average temperatures from 90°F in the low country to 60°F, with an occasional ground frost, in some of the up-country areas.

As is to be expected with such a wide range of climatic conditions, the weed problem varies considerably in intensity and to some extent in the relative importance of the different weed species. The normal pattern of tea estate maintenance includes regular monthly weeding rounds throughout the year on each field. Weeds are removed by hand scrapers and left in the field, often increasing the weed problem by shedding viable seed. Hand scrapers loosen the topsoil and increase the tendency to erosion by heavy rainfall, especially on the steep slopes of up-country estates. When weed growth gets out of hand, weeds may be removed and left at the edge of the field. Virtually no mechanical cultivation is used, the difficult terrain precluding this on most estates. In the past, chemical weed control was not possible as the available herbicides were liable to damage the crop.

Spraying gang mixing the 'Simazine 50W' before filling the sprayers

Low-country and up-country

In low-country areas, under conditions of high rainfall and high average temperature, weed growth is lush and rapid. Monthly weeding rounds may cost between Rs. 30 and Rs. 35 (£2 5*s*.-£2 12*s*.) per acre, per month. There is no large population of resident labourers, estates depending for some of the work on casual village labour. The work load frequently exceeds the capacity of the available labour and unreliable supply tends to make estate maintenance a problem; hand weeding often has to take second place to more productive work, such as plucking the tea and spraying against blister blight.

In up-country tea areas, weeding is a less serious problem. Climatic factors are less favourable for rapid weed growth and there is a large settled labour force on most estates. Monthly weeding rounds under these conditions can be carried out at a contract rate of Rs. 8-10 per acre (12*s*. 6*d*.-15*s*.) per month.

Whatever the climatic conditions on an estate, however, weed growth is most rapid during the monsoon periods, when the tea flush is greatest; then the labour force is needed for the two most important jobs of plucking and blister blight control. It is during the monsoon, therefore, while the demands on the plant are heaviest, that weed competition for soil nutrients is most serious and yet it is at this time that weeds are most likely to be allowed to get out of hand.

Role of chemical weed control

Depending on climatic and labour conditions on each estate, chemical weed control may be of benefit in one of the following four ways:

Long-term weed control—continuous chemical control on a field scale as part of estate practice.

Period weed control—to cover the period of maximum weed competition after planting out, or following pruning while waiting for the tea to cover in.

Short-term weed control—to deal with relatively short periods when manual weeding cannot readily be carried out.

Barrier weed control—to prevent weeds encroaching into the tea fields from drains, gulleys, roadways and adjacent jungle.

The new group of persistent soil-applied weedkillers, the triazines, especially simazine* (solubility five parts per million), which kill weed seedlings by root absorption, but to

*Marketed and used as a wettable powder, 'Simazine 50W'.

which perennial shrubs and trees with deep and extensive root systems are largely resistant, hold every promise of safe employment in these four ways. In addition, its prolonged use may reduce the actual weed seed potential in the soil. It has been shown on an estate in Ceylon that on a trial area where simazine was used at 4 lb. and 6 lb. per acre (and weed control had terminated several months earlier) the new crop of weeds was only one-third as heavy as that on the unsprayed area.

Preventive weed control

As long as herbicides such as simazine remain in the top inch or two of the soil, they will continue to act on weed seedlings, causing their chlorosis and death. The length of persistence of the chemical in the soil depends on the intensity and frequency of rainfall, air and soil temperatures, weed population and species and soil type because the rate of breakdown of simazine in the soil varies with these factors. Experience in Ceylon has shown that residual weed control after the application of 2 lb. of the wettable powder per acre will be maintained until 10-20 in. of rain have fallen and after the application of 4 lb. per acre until about 15-40 in. of rain have fallen. (Table 1)

The dosage rates of simazine used will therefore depend on the type of weed control desired and the location and climate of individual estates. For continuous weed control initial applications of 2-4 lb. of the wettable powder should be repeated as soon as the soil residue is exhausted and before weeds have regrown beyond the seedling stage. By this method between 8-12 lb. will be required for an up-country estate during the first year (and 12-20 lb. simazine for a low-country estate), with the prospects of reduced dosages in successive years. For period weed control programmes dosages of 2-4 lb. per application give the most economic advantage. For short-term control programmes the lowest dosage of 2 lb. per acre is the most economic.

Method of application

Soil-applied, relatively insoluble herbicides, such as simazine, are sprayed as suspensions of wettable powders in water; even application of the desired dosage on weed-free soil is of the utmost importance to ensure maximum effectiveness. In Ceylon, where most

Spraying 'Simazine 50W' in mature tea. Note lance held beneath leaf canopy to ensure even ground cover

of the tea is already sprayed with fungicides from knapsack-type sprayers filled under pressure, it is best to use existing machinery and to maintain the walking speed of the labourer at the same rate as for crop protection spraying. This requires some adjustment in the size of the nozzle used.

It is safe to spray simazine on the tea bush, but to achieve the best ground cover, mature tea and some low-country pruned tea should be sprayed by directing the nozzle *under* the tea bush branches. In up-country pruned tea the spray lance should be held 18 in. *above* the bush to obtain an even cover. A volume of 50 gal. of water per acre gives a sufficient cover in pruned tea, but in mature tea, or for areas difficult to spray, 70 gal. of water to the acre may be necessary. Best results are obtained when simazine is applied immediately after a monthly weeding round. The need for close supervision to ensure efficient and accurate application and correct dosage rates cannot be overstressed.

Crop safety

The margin of safety required from a chemical used in tropical estate conditions and applied by unskilled labour is high, especially in a crop as sensitive and as valuable as tea. Simazine has shown a very wide safety margin in tea as far as visual effect on the plant, quality and quantity of leaf produced and the health of operators is concerned. It has had widespread field testing in Ceylon, India, Mauritius and East Africa on mature tea at dosages up to 16 lb. per acre for single application; at no time have there been any symptoms of damage either on bearing tea or on tea at any stage recovering from pruning.

In addition, yield experiments have shown that the output of simazine-treated tea is unaffected. The mature plant appears to be partially tolerant to simazine even if the chemical is incorporated in the soil round the root zone; dosages equivalent to 16 lb. per acre incorporated in the soil have produced no damage, although at very high dosages (over 60 lb. per acre)

Table 1

Rainfall and effective weed control

Dosage rate	*Estate (Ref. No.)*	*Period of effective weed control (weeks)*	*Rainfall during period of weed control (in.)*
2 lb./acre	(1)	6	18
	(2)	5	16
	(3)	4	11
	(4)	5	12
	(5)	12	18
	(6)	9	28
	(7)	4	12
	(10)	4	23
4 lb./acre	(3)	8	19
	(4)	8	30
	(5)	24	30-37
	(6)	9	28
	(7)	18	24
	(8)	12	40
	(9)	18	31
6 lb./acre	(7)	22-26	35
	(9)	18	31
8 lb./acre	(5)	30	50

marginal damage symptoms have appeared. Deliberate single over-dosing with up to 80 lb. per acre has not resulted in damage when applied to the soil surface, nor has repeated application of dosages in excess of those used for field trials. Very young tea, shortly after planting out, is more sensitive to simazine and dosages equivalent to 60 lb. per acre have resulted in scorch on young plants two to six months after planting out. In field trials dosages of up to 2 lb per acre on tea two months after planting out have been shown to be safe. No effect on the quality of the tea leaf or on the flavour of the made tea has resulted from any of the tests.

The properties of simazine give a high safety factor on other counts; the mammalian toxicity is so low that it is harmless to the operators; the low solubility and lack of foliage absorption avoid any hazard from spray drift; the material, once washed into the top layer of the soil, does not creep laterally and there is little danger to adjacent crops.

Resistant weeds

Although simazine at the dosages used controls seedlings of virtually all broad-leaf weeds and grasses, some species, *Strachytarrheta jamakensis*, *Cardamine tricocarpa* and *Drymaria cordata*, are partially resistant to low dosages and have not been well controlled at 2 lb. 'Simazine 50W' per acre, but have responded to higher application rates.

Some species which have aerial stem systems which root at the nodes, such as *Polygonum nepalense* and various *Commelina* sp., appear to respond to herbicides at the seedling stage, but pieces of the stem systems left on the ground after manual weeding appear to be able to keep alive long enough to root in soils to which these low rates of simazine have been applied.

Species which have long tap roots and persistent underground root and stem systems are partially resistant to simazine. Couch grass, *Panicum repens*, illuk grass, *Imperata cylindrica*, nut grass or cora, *Cyperus rotundus*, and bracken fern, *Gleichenia* sp., have so far been resistant to low dosage rates. Species of oxalis, *O. corniculata*, *O. corymbosa* and *O. latifolia*, maidenhair fern and some chrysanthemum species have been resistant, but in some cases have suffered necrosis, some distortion and die-back.

Summary

The work done in Ceylon with simazine shows that there is great potential benefit in a weedkiller which by its persistence will help to reduce the cultivations necessary and therefore decrease erosion; which will act as a seedling weedkiller so that a 'dirty' soil may be cleaned; which will have a wide spectrum of herbicidal activity, but will also be selective so that some type of a permanent cover may be left in control or established where necessary, and which will have a low solubility in water so that it will be less subject to the leaching caused by the heavy rains of the tropics.

Weed control with 6 lb. 'Simazine 50W', two months after application. The ground on the extreme left of the picture has not been sprayed

Maize in Brazil

Maize was formerly grown in Brazil only to satisfy local requirements. In 1960, however, the state of Sao Paulo alone harvested 1.8 million tons, nearly 480,000 tons more than in the record harvest of 1959. Large increases are also expected in other Brazilian states.

Brazil still possesses immense areas which are slowly being economically developed and maize, thanks to its short growth cycle and usefulness, has always been grown in opening new land. The farmhand who clears the strips between rows of coffee plants has the right to plant maize between the rows for the first four years. Today, however, maize has become a large-scale cash crop for a market which has already grown sufficiently to justify this expansion. In Sao Paulo this progress is supported by the distribution of selected seed. In view of export possibilities, a private company is now to open a modern factory for the treatment and storage of maize.

Cattle and poultry breeding have expanded enormously in Brazil in the past few years, thanks to maize products, of which about two-thirds are imported. Apart from the inevitable fluctuations in imports, which periodically cause shortages, there has also been a serious excess of demand over supply. The solution of this problem has been to plant more maize, thus assuring the development of milk herds and poultry in the regions of Sao Paulo and Rio de Janeiro.

Sao Paulo always absorbs the commercial harvests of the border states because local firms use maize as raw material in the manufacture of products such as oil, flour and corn flakes. Maize does not usually appear on the list of products exported from Brazil; the last time this occurred was in 1955, when only 80,094 tons were exported. The quantity to be exported from the current crop depends on international prices, the exchange rate, weather conditions at harvest time and the storage and transport facilities available.

Sugar-beet in Pakistan

H. KAMPF,* DR.TECH.SC., F.R.I.C.

During the last decade a sugar-beet industry has been established in North-West Pakistan in what was predominantly sugar-cane country. In 1950 some 50 tons of sugar-beet were grown as an experimental crop; it was so successful that in 1959 a beet sugar factory with a capacity of 1,500-2,000 tons of sugar-beet a day was erected.

WHEN reviewing the sugar industry in Pakistan or India one usually associates it with sugar produced from cane, which is native to the tropical and sub-tropical regions of the Orient. It is, perhaps, not generally known that various attempts at establishing sugar-beet cultivation have been made in the northern tracts of the Indo-Pakistan sub-continent, which lies well outside the temperate zone.

Sugar-cane field in the Peshawar Valley, Pakistan. In the foreground there is a wheat crop

Trials in India

It was in about 1930 that H. Martin-Leake[1] carried out a series of trials to ascertain the possibilities of sugar-beet in Bihar, Northern India. The average yields of sugar-beet per acre, covering two successful seasons, were about 20 tons and the sucrose content was satisfactory.

These experiments were repeated by the British India Corporation in the same area during the cold weather of 1955. Planting of the seed was done in November, which is about as early as is possible in Bihar. The beet, harvested at the end of April 1956, had a sugar content of 17.4%. The yield of roots was over 15 tons per acre, thus more or less confirming the results obtained 25 years previously.

Trials in Pakistan

As early as 1916, experiments were conducted by W. Robertson Brown,[2] Agricultural Officer of the North-West Frontier Province, to demonstrate that sugar-beet could be grown satisfactorily in the fertile Peshawar plain, which is now a part of West Pakistan. At his instigation beet was sown on ridges, 24 in. apart, and Federation wheat was drilled between the lines of beet. One acre of land belonging to the agricultural farm at Tarnab was inter-cropped in this way in mid-October 1916 and the trial plot irrigated six times from the date when the wheat was sown. No manure was given before or after the crops were sown, but the beet and wheat followed sugar-cane and a summer fallow.

This one-acre experimental plot yielded one ton of good grain and about 16.5 tons of sugar-beet. Twelve of the beet roots were analysed by the Imperial Agricultural Chemist and the average value for the 12 samples was: sucrose, 17.14%; glucose, 0.263%.

Recent research in Pakistan

Intensive research on the cultivation of sugar-beet in North-West Pakistan was started in 1950 under the direction and control of Mian Obaidullah Jan,[3] Deputy Director of Agriculture, at the newly-established Sugar Cane Research Station at Mardan.

The results of this work again showed that sugar-beet can be grown successfully in the Peshawar plain, but it further revealed that approximately 50% more sugar per acre can be obtained with beet than with cane, and in nearly half the time. In addition, it was demonstrated that acreage planted to sugar-beet would result in increased profit to the farmers and permit the three sugar mills there to produce sugar for two extra months a year, thus increasing industrial employment and profits.

The varietal trials with sugar-beet at Mardan included the seed of more than 90 varieties imported from eight European countries, including Britain, from Turkey and Iran and from the U.S.A.; a number of these did exceptionally well. The best adaption to the climatic, soil and growing conditions in the Peshawar plain was shown by selected varieties from Einbeck in Germany (Kleinwanzlebener Saatzucht), from Holland (van der Have) and from Hungary (Agrimpex).

Seeding and harvesting

The results from the seeding and

* Premier Sugar Mills, Mardan, Pakistan.

harvesting trials showed that planting done between the middle of September and November gave best results. Harvesting may be started any time after the middle of April and continue to the end of June, but the lifting of the last mature beets must be completed before the hot weather sets in.

The harvesting period for sugar-cane in North-West Pakistan is from November till the end of May, which coincides with the beginning of the sugar-beet harvest. This will enable the existing cane-sugar mills to extend their working seasons from the present six months to eight, provided equipment for handling beet is added.

At present further experiments have been laid down around Mardan and at a higher altitude, some 3,500 ft. a.s.l., in Swat State in order to find out whether KW-Polybeta and KW-Interpoly seed sown in February and March will reach maturity about the end of October. Any sugar-beet lifted in October or the first week of November could then be processed before the sugar mills start their sugar-cane season, so extending the period of operation still further.

Cultural trials covered planting of the seed on the ridge and on flat seedbed with distances between the plants ranging from 9-15 in. in the row and widths of 18, 24 and 30 in. between the rows.

Loading sugar-cane in Pakistan

Commercial growing

It has been proved by experiments conducted at the research station at Mardan and with the collaboration of many farmers, who grew sugar-beet on a commercial scale, that under average conditions in the Peshawar plain, the following method of land preparation and planting of the crop should be adopted for obtaining maximum yields of sugar per acre.

Ploughing should be done as deeply as the subsoil permits, *i.e.* to a depth of 9-12 in. As there are still very few tractors and farm machines available in Pakistan, most of the small farm holders use simple hand tools and ploughing is done with a wooden, iron-tipped 'cultivator' drawn by a pair of bullocks. These one-row cultivators are in common use, but require two runs—the second across the first.

All the crops are grown on the ridge. The ridges are dressed by hand. To obtain a plant population of about 30,000 plants per acre, theoretically the best arrangement of plants for the conditions in Pakistan is rows of 24 in. apart with a 9-in. spacing between plants. The seed is supplied by the factories at a rate of 8 lb. per acre and is placed in moist soil about $\frac{3}{4}$-1 in. deep. Thinning and hoeing is done by hand. As most of the cow dung, after drying in the sun, is used as fuel, dressings of about 5 cwt. of ammonium sulphate and 3 cwt. of superphosphate per acre are recommended. Good results have also been obtained by the use of $2\frac{1}{2}$ cwt. of ammonium sulphate nitrate, which contains 26% N.

Sugar-cane in Pakistan is a 12- and 14-month crop, whereas sugar-beet only requires six or seven months to reach maturity, and it is possible to grow another crop, such as maize, on the same land a year later. It has also been proved by experiment in the Peshawar plain that by growing sugar-cane in the furrows between the rows of sugar-beet that the yield of sugar per acre from such mixed planting is considerably greater than with either grown alone.

The beet is planted on top of 2-ft. rows in September and harvested in May; cane is planted in October in every other furrow, *i.e.* 4 ft. apart, and harvested the following year in December and January. Inter-cropping of beet and wheat is also being done successfully on a commercial scale.

Water requirements

The average annual rainfall in the Peshawar plain is only 15 in., with two marked rainy seasons—the summer rains in July and August and the winter rains in February and March. For the growing of sugar-beet only the winter rainfall of about 5 in. is of any use, but the north-western part of this region is served by the well-planned irrigation system of the Swat and Kabul rivers. Irrigation trials on sugar-beet and sugar-cane, conducted at the Sugar Cane Research Station, have revealed that only 50 acre-in. of water are required for sugar-beet, while for sugar-cane 90-100 acre-in. are needed to obtain maximum yields of sugar per acre.

Harvesting and yields

Harvesting is done by hand after the beet have been ploughed out by means of the bullock-drawn plough. Topping of the lifted beet is also done by hand, an operation requiring skill and careful supervision.

The cultivation of the sugar-beet in North-West Pakistan on a commercial scale during the last few years has confirmed that the yield of sugar per acre is higher from beet than from cane. The average results are given in Table 1 and the figures show that from the beet grown on one acre of land 2.08 tons of sugar can be recovered in the sugar factory, while cane yields only 1.01 tons.

Sugar-cane is liable to damage by frost. In North-West Pakistan, the temperature may fall to below 32°F during the winter. Prolonged cold spells with night frost are common from the end of December to February.

Left: *A Pakistan farmer tending his four-month-old crop of sugar-beet.* Right: *Ploughing out the mature sugar-beet in North-West Pakistan*

The average yield of sugar from healthy cane is about 8% in North-West Pakistan, but in 'frost' years the quality of the cane is badly affected and the factory yield is reduced to below 6% sugar. These light frosts are, however, no danger to the sugar-beet.

Crushing sugar-beet and cane

At the beginning of the past decade only about 50 tons of sugar-beet a year were being harvested from the experimental plots in the Peshawar plain. These small quantities were used up for analysis in the laboratory and consumed as cattle feed. The disposal of the crop became a problem when the farmers were encouraged to grow sugar-beet on introductory plots on a larger scale. Seed was supplied by the cane-sugar factory to the grower free of charge and for the topped sugar-beet delivered to the mill a 20% increase over the price for sugar-cane was promised and paid.

At this stage the writer improvised a method to shred and mill cane and beet together in 85 : 15 ratio to provide some means for recovering the sugar from the beet, as none of the three existing mills in the north-western region of Pakistan was then equipped with beet-processing machinery.

The first combined crushing of beet and cane was carried out successfully in May 1955, when 79 tons of beet were processed in this way by the Premier Sugar Mills at Mardan. By this expedient all the sugar-beet harvested in the Peshawar plain was utilised till recently. In 1956 116 tons of beet, and in 1957 476 tons of beet, were so treated. By 1958 the Premier Sugar Mills and the Charsadda Sugar Mills were already handling 1,773 tons of beet, together with cane.

Table 1

Comparative yields of sugar-beet and sugar-cane

Yields per acre, 1952-58

	Cane	*Beet*
Weight, tons..	13	16
Sugar content	10.25%	15.5%
Sugar recovery in the factory	7.75%	13.0%
Actual yield of sugar ..	1.01 tons	2.08 tons

Sugar-beet machinery

The favourable results obtained by this method of combined processing had important consequences for the development of the beet-sugar industry in North-West Pakistan, as in 1958 the Government decided to allow the necessary foreign exchange for the purchase of beet-washing and slicing machinery and processing equipment to handle 1,500-2,000 tons of beet a day.

The machinery was duly imported and erected on land adjoining the cane-sugar mill at Charsadda. In August 1959, during a 10-day trial run, 4,460 tons of beet were sliced and the resulting juice was processed in the sugar house of the cane-sugar factory. In addition, 3,119 tons of beet were crushed in the cane mills of the Premier and the Leiah Sugar Mills. Altogether a total of 7,579 tons of beet were processed into white sugar in North-West Pakistan in 1959.

During the beet campaign, from 15 May-2 July, 1960, the Charsadda beet-sugar plant was in operation. The new mill dealt with the crop from about 4,000 acres and produced 2,153 tons of white sugar from 23,867 tons of sugar-beet.

The Pakistani farmer has been quick to realise that the by-products of the beet crop in the form of crowns, leaves and pulp are of considerable value as economical feeds for cattle, sheep and horses. As further experience is gained there are good prospects for an extension of the area under sugar-beet in the northern parts of West Pakistan.

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Seeds and Hoes for Congo

Seeds and hoes have been sent by FAO, sufficient for the spring planting needs of the Congo's South Kasai famine area.

Dr. Norman Wright, Deputy Director-General, has said that a total of 300 tons of maize, groundnut and bean seed had been bought by FAO in neighbouring countries and 10,000 hoes have been purchased in the Congo. This is more than three-quarters of the seeds needed for immediate planting and another 100 tons of groundnut seed was to be sent as soon as it can be put to use.

Progress in Weed Control

3—Control of Bracken

Photos on this page: Miss S. A. Grant

Tall, dense bracken which is quite useless for grazing purposes, although on potentially very productive land

IN introducing the subject of the control of bracken in hill pastures at the Fifth British Weed Control Conference, *Dr. I. A. Nicholson, of the Hill Farming Research Organisation, Edinburgh*, said that the bracken problem does not differ essentially from that of controlling the other plant communities composing upland pasture. The special interest in bracken arises from its occupation of some of the better soils, capacity for rapid spread with consequent depletion of the sward, and its tendency to poison cattle.

In many other respects the problem of bracken differs from that of other communities only in degree and our present inability to control it is one example, among many, of the inadequate control we have at present on ecological trends in upland pasture and therefore on the quality and productivity of its herbage.

Although the acreage of bracken infestation throughout Britain is extensive, the area on the hill itself which could be profitably destroyed may be limited. There is no doubt that routine bracken control is an essential element in maintaining production on hill grazings, but large-scale clearance is unrealistic without measures to improve the husbandry techniques which are the fundamental cause of its existence.

Its eradication should be regarded as the first step in a programme of improvement involving measures to establish and maintain a useful pasture in its place. In many cases this might bring about an increase in the productivity of the hill land, but to ensure a permanent improvement positive measures to maintain fertility are essential. A proper balance must be achieved between immediate economic advantages and the long-term demands of sound land use.

The following are short abstracts from the papers given in this session of the Conference:

Considerations in Judging Control Methods of *Pteridium aquilinum* **by** *E. Conway* (*Department of Botany, University of Glasgow*)

Although the usual methods of judging control methods of *Pteridium aquilinum*, the common bracken fern, are by frond counts from unit areas, it is now widely recognised that the expanded fronds of this plant are only seasonal and temporary organs, and that effective attack must be directed towards the extensive underground system from which the fronds arise. This is the agent responsible for invasion as well as for the plant's ability to pass the winter in a healthy state ready to begin further growth and expansion the following year.

The tangled mass of rhizome which is found, when bracken land is dug, is really a large number of branches, each with a marked growing-point at the tip and each capable of forming a new and separate centre of growth and development.

They fall into three categories: 1. Thick ones that run deeply into the soil and are the main agents responsible for the outward expansion of the colony. Normally they carry few fronds or frond buds, but if any factor causes them to grow up towards the surface of the soil they initiate frond buds that later come above the soil as expanded fronds. 2. Thinner, smaller branches running near the soil surface; these are the main frond-bearing branches. 3. Intermediate branches linking 1 and 2 and capable of developing into either as environmental factors act on them. Branches 2, with their frond-bearing function, are those of immediate interest, though branches of type 1 are those which give the plant its considerable resistance to extermination.

Bracken stand with some herbage below the canopy. This may be used for grazing for short periods of the year before fronds develop

The evaluation of a treatment by counting fronds on a unit area in the following years reflects the number of frond buds that escaped the effects of treatment and are later able to expand. This number is further conditioned by the extent of the rhizome development in the treated area before treatment was applied.

The very great advance resulting from foliar spraying with certain of the translocated herbicides is that the branches affected are killed and are

Photos: R. C. Kirkwood, West of Scotland Agricultural College

Left: *Area of bracken a year after spraying with 4-CPA herbicide at 9 pints per acre.* Right: *The same area a year later, showing the marked regeneration of the bracken*

unable to develop further. In the case of defoliation treatments, the growing points are not killed. Though their rate of development may be reduced, they remain as growth centres and, sooner or later, fully-formed fronds will again expand from the apices of all the branches.

Some Aspects of the Chemical Control of Bracken (*Pteridium aquilinum*) *by J. Norris* (*A. H. Marks & Co. Ltd.*)

The extensive rhizome system of bracken with its large number of frond buds invariably possesses an unfavourable ratio of growing fronds to potential frond buds. To give control of a high order, a chemical must be capable of being easily translocated at lethal dosage over relatively long distances within the rhizome. The amount of chemical translocated is, within limits, dependent on the quantity penetrating the frond cuticle and this in turn is probably dependent on the stage of maturity of the bracken.

These and other factors limit the degree of control obtained with chemicals. To date a reduction in the bracken density of 70-80% appears to be possible under normal climatic conditions. Reductions of a higher order have been obtained and investigations to evaluate the conditions under which these higher reductions take place are still going on.

Trials with a range of herbicides were started in 1955 in Scotland and in 1958 in England. Hormone-type herbicides have been found to be most effective, particularly emulsifiable ester formulations of 4-chlorophenoxyacetic acid, 4-CPA.

The Control of Bracken—A Progress Report on Herbicide and Post-spraying Management Trials *by R. C. Kirkwood* (*West of Scotland Agricultural College*)

Dalapon, amitrole (with and without ammonium thiocyanate) and 4-CPA were compared at two sites as bracken killers, each being sprayed at two dosage levels and at two dates.

On assessment of frond density a year after spraying it was found that none of the chemicals gave a satisfactory control. Reduction in frond density increased with dosage level and with earlier spraying. It may be that the optimum time of spraying depends on the stage of frond maturity and rhizome bud development.

Results, showing the influence of litter removal and fertiliser treatments on sward germination and establishment on sprayed bracken land, were also presented. Litter removed by fire or by mechanical raking had little effect on sward establishment; removal by molasses application, however, resulted in a significantly increased yield six months later (box trial). Lime and slag, but not nitrochalk, significantly increased yield.

Interim Report on Bracken Control Trials *by D. S. C. Erskine* (*Edinburgh School of Agriculture*)

Brief details were given of experimental work carried out on the control of bracken by herbicides. The results of an investigation on time of application suggest that the beginning of August was the optimum stage for treatment by 4-CPA formulations.

In an experiment investigating dose rates, dalapon gave a maximum of 35% frond reduction at 20 lb. a.a.e.* per acre and caused almost total kill of the underlying grass, while the nonyl ester, butyl ester and diethanolamine salt of 4-CPA gave maximum reductions of 46%, 54% and 74% respectively in the year following treatment.

Activated amitrol emerged as a very successful treatment, giving frond reductions of from 81-95% at rates from 5-15 lb. a.a.e. per acre. Three field-scale trials were described in which amitrol again showed the greatest degree of bracken control and would appear to offer considerable promise in this field.

It would be foolish to consider these interim results as being indicative of the performance of the materials tested; the summer of 1959 was not an average one, and results obtained then may not necessarily tally with those obtained under more normal weather conditions. It is also difficult to use the results as a basis for advice when only one year has elapsed since the treatments.

Three important points have emerged from this series of trials: in the first place, because of its damaging effects on the underlying sward grasses, dalapon should be ruled out for use

* a.a.e.: active acid equivalent.

where bracken is infesting the better hill grazings; secondly, amitrole has emerged as a promising herbicide for the control of bracken, although such use is not yet entirely economic; in the third place, it would appear that further work is essential before any existing 4-CPA formulation can be recommended with confidence for general use.

Dalapon, 4-CPA and Amitrole for the Control of Bracken—An Interim Report *by G. L. Hodgson (A.R.C. Weed Research Organisation)*

Dalapon, 4-CPA and amitrole have been tested for the control of bracken in 13 randomised block trials distributed in 10 counties of England and Wales. Drought conditions during most of the season may have affected the results and this should be borne in mind in their interpretation.

Doses of 10 and 20 lb./acre of dalapon gave variable results. Although frond emergence was delayed, the continued emergence of fronds during the season resulted in an unsatisfactory level of control by the end of the season. Where grasses and other species were present they were completely suppressed. The sodium salt of dalapon does not appear particularly useful for the control of bracken.

The three ester formulations of 4-CPA tested showed similar activity on bracken, but the results were, in general, very disappointing compared with the promising results in earlier trials. It is clear that the control of bracken with 4-CPA is liable to vary from site to site and from year to year and until further evidence is forthcoming on the principal factors responsible for this variation it cannot be considered a reliable herbicide for bracken using up to 10 lb./acre.

June and July applications of activated† amitrole at 10 and 20 lb./acre gave an excellent control. Later applications gave a reduced control. Further work is in progress to assess the optimum dose for acceptable control, to determine the period of maximum susceptibility and to test the reliability of the chemical under various environmental and climatic conditions.

†Activated with ammonium thiocyanate.

The method of applying the herbicide using the 'Oxford' precision sprayer

Experimental Crops in U.S.S.R.

COCOA

Since 1955 the U.S.S.R. has been engaged in extensive research on the possibilities of growing cocoa in the sub-tropical regions along the coast of the Black Sea.

Trials have been made near the town of Garga in Abkhazia on various methods of nursing young cocoa trees through the winter. Trees have been grown in trenches to protect them from the worst of the cold, but this method failed. Some trees have been grown in tubs in the open during the spring, summer and autumn and have been moved into heated glasshouses during the winter, but this was an expensive and not very satisfactory method. Still more trees have been raised entirely in unheated glasshouses, but even here the air temperatures must not fall below 6 to 8°C and the critical soil temperature is 14°C. The best results have been obtained in heated glasshouses, where cocoa trees have fruited at the age of four or five years and have produced beans of high quality, close to that of the export grades in the leading producing countries.

[*It is not clear what is the object of these experiments, for the project is bound to be uneconomic as a source of cocoa supplies for Russian consumption.* —Ed.]

LAC

Lac is a resin, produced by an insect of the Coccidae family, which is marketed commercially as shellac. India produced 90% of the world's supplies, about 30,000 tons a year, valued at about £2 million.

India, Indo-China and China itself have long been virtually the only lac-producing countries of the world. However, the U.S.S.R. has been trying to acclimatise the lac-producing insect, *Laccifer lacca*, in the warmer parts of the U.S.S.R. and to find or provide suitable host plants.

The first trials were made in Tadzhikistan in 1944, using insects brought from India. They grew normally and reproduced. Since then, however, it has been found that the Lenkoram plain in Azerbaijan, the Atrek region of Turkmenistan, the Caspian coast of Georgia and, above all, the Black Sea coast of the Caucasus are much more suitable for its introduction. Experiments have been going on since 1956 under glass at Leningrad and in the open at Sukhumi, Batumi and Anaseuli on the Black Sea coast, using insects brought from South China, a journey of 12,000 miles.

Several indigenous and introduced trees have proved perfectly suitable host plants, *e.g. Zizyphus jujuba*, *Diospyros* species, *Ficus* species, *Hovenia dulcis*, *Corylus maxima* etc.

The process of lac formation during the summer is like that in India and China, and the product has been found to be perfectly normal. In 1960, a permanent experiment station was set up at Sukhumi to improve the cultivation of the host plants and to investigate means of controlling predators and parasites of *L. lacca*.

World News

Egypt

Increased Production Planned

During the last 10 years the population of Egypt has increased by about 25%, but the area under cultivation has grown by only 10%. The efforts of the Government to improve cotton growing by better varieties, increased use of fertilisers and greater care in plant protection have brought about an increase in the yield of 15%. In sugar-cane the yield has increased by 25%, in rice by 20% and in onions by 10%.

In the present Five-Year Plan it is intended, in addition to other large projects, to extend the arable area by 914,270 acres to 6.9 million acres, so that agricultural production will increase in value from £E135 million to £E171 million.

Hungary

Plans for Agriculture

More details of Hungary's economic plan for this year, first in the new Five-Year Plan period, have been issued in Budapest. It is aimed to raise industrial output by 8%, agricultural production by 7.9% and wages by 1.8% as compared with 1960.

Emphasis is being placed on cereals, maize, sunflower seed, sugar-beet and early and late vegetables.

Among livestock the standard of milking herds is to be raised with the object of pushing up milk production from the 1959 national average of 475 gal. to 520 gal. per cow.

Capital investment in agriculture will be 5,100 million forints, of which nearly half will go to co-operative farms. (100 forints: £3).

Removing sisal waste from a pit on a Kenya farm. The waste is saturated with water of high acidity and after a few loads the going gets very sticky. The tractor in use is a Fordson 'Power Major' with four-wheel drive, fitted with a front-end loader

Kenya

Success of Sisal

Over the last half-century the production of sisal in Kenya has grown from a few tons to 60,000 tons per year. During the last two years the production of sisal, which is used in the making of ropes, bags and twine, has increased by 15,000 tons or 25%. This increase is as much due to improved cultivation as to increased planting, according to Mr. Bruce McKenzie, Minister for Agriculture, when speaking at a sisal planters' meeting.

The sisal industry also played an important part in the stabilisation of the employment of labour, he said. By employing 25,000 labourers daily it was giving a steady living to a large number of people in Kenya.

Ghana

New Sugar Industry

A £G3½ million sugar industry is to be set up at Komenda, midway between Cape Coast and Takoradi. Eight thousand acres of land have been acquired for the cultivation of sugar-cane, which is to be processed locally. It is hoped that the first Ghana-made sugar will be on sale by 1963.

Rhodesia

Weeds on Lake Kariba

The Director of the Game and Fisheries Department, Mr. F. I. Parnell, recently reported that weed infestation on Lake Kariba was rapidly reaching emergency proportions. Mr. Parnell thought the answer to Kariba weed might be chemicals, although these were expensive. Other possibilities were the use of a fungus, virus or insect to destroy the weed, botanically known as *Salvinia auriculata*. He said the weed had already closed down several fishing stations on the lake.

Dominican Republic

Coconut Products Factory

A factory is being equipped at Samana, Dominican Republic, for the manufacture of coconut products. These will include copra, coconut oil, cosmetics and soap. One section will produce textile and other materials from coconut leaf and bark.

India

Sugar-cane Diseases

Dr. B. L. Chona, who has been engaged in the study of diseases of sugar-cane for more than 25 years, recently presided over the section on agricultural sciences at the Indian Science Conference and spoke on red rot of sugar-cane, 'the most serious disease of this crop in India'.

For effective control of the epidemic, he suggested that the banning of the cultivation of susceptible cane varieties in an entire cane tract, as well as in the affected areas, was essential and might be achieved even through legislation.

'20 MULE TEAM'

Healthy crops begin with BORON

ROOT AND FORAGE CROPS

Common symptoms of boron deficiency are "Heart Rot" of sugar beet, "Brown Heart" of turnips, hollow stem of kale, yellowing and stunting of lucerne and failure to set seed in clovers.

TREE AND FRUIT CROPS

Growth, yield and keeping quality may be seriously affected by boron deficiency. Under these conditions great improvements have followed the addition of boron to coffee, citrus, grapes, apples and hops, and even forest trees may benefit.

VEGETABLE CROPS

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Boron is essential for satisfactory growth in all crops, especially where the soil is low in this element or deficiency has been induced by overliming. When these conditions occur the application of borax or a boronated fertiliser, or foliar spraying, restores the boron balance, resulting in improved yield, quality and appearance at little extra cost.

Copies of "Boron Deficiency — its Prevention and Cure" a '20 MULE TEAM' publication are available from the Agricultural Department, who will be pleased to recommend the most suitable '20 MULE TEAM' product for your application.

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World Crop Reports

INTERNATIONAL REPORT

Jute

Early estimates of the 1960 world jute production indicate slightly larger crops in all reporting countries except Taiwan. The total of 4,338 million lb. compares well with the relatively small 1959 crop of about 4,144 million lb., but is 6% smaller than the 4,628 million lb. in 1958.

The official estimates for production in *India* and *Pakistan*, sources of approximately 95% of the world supply, are about 165 million lb. more than in 1959. Some trade estimates of the crops from this area are about 5% more than these official reports indicate, but trade estimates are sometimes reduced later in the season.

The world crop at either estimate would hardly be large enough to allow much build-up of the currently depleted stocks of fibre and goods after the world's needs for the coming season are met for burlap, bagging and other manufactures. World consumption is increasing each year in spite of considerable competition from other jute-like fibres and other means of handling goods in storage and transit.

The 1960 jute crop in Pakistan and India was 4-6 weeks later than usual in reaching the market because of especially unfavourable weather in the principal producing areas during the planting and early growing season. The lateness of this year's crop following immediately after the preceding year's comparatively small output caused stocks to be reduced to an exceptionally low level by the end of the 1959-60 season.

Jute exports from Pakistan, the principal exporter, were about 1,887 million lb. in 1959, an increase of about 130 million lb. over 1958; however, a decrease of possibly 85 or 90 million lb. is forecast for 1960.

India, the largest manufacturer of jute goods, imported over 240 million lb. of jute fibre from Pakistan in 1959, compared with only about 135 million in 1958. This increase resulted from a decrease of about 245 million lb. in supplies from the Indian domestic crop.

Domestic consumption of raw jute is increasing in both India and Pakistan, together totalling about 3,437 million lb. in the crop year beginning July 1959 and 3,208 in 1958-59. The 1960-61 consumption is forecast at around 3,480 million lb.

REGIONAL REPORTS

Portugal

The 1960 *wheat* crop is forecast at 16.7 million bushels. This is about 13% below last year's out-turn and is only a little more than half the record crop in 1958. Lower prospects for all grains this year mainly reflect adverse winter weather. Preliminary estimates place current wheat acreage about 3% below the 1959 acreage.

France

Flax fibre production in France is now forecast at nearly 70 million lb. in 1960, the largest crop of the last three years. Production fell from 78 million lb. in 1957 to 59 million in 1958 and 53 million in 1959. The yield per acre was above average at 687 lb., but not as high as the 1959 yield of 749.4 lb., which was the peak peace-time yield since 1934.

England and Wales

Wet soil conditions were most unfavourable for autumn cultivations and field work. Little progress was possible except on the lighter soils. Much less winter corn than usual had been sown; seedbeds were generally poor and germination slow except for a few earlier sown crops.

The acreage of autumn-sown *wheat* was very much less than usual. The condition of early sown wheat was satisfactory, but later sown crops were patchy, due to waterlogging, and were slow to germinate. There were several reports of slug damage. The limited acreages of *barley* and *oats* were generally progressing satisfactorily, but some damage had been caused by flooding and excessive rains. *Rye* made good progress. The small acreage of *beans* sown appeared to be satisfactory, although growth was slow in some areas.

About 90% of the *potato* crop had been harvested by 1 January. It seemed likely that much of the remainder would be lost. The keeping quality was very variable. Some potatoes kept rather better than expected, but their quality in clamps was generally not so good as those in stores. There were reports of sprouting in clamps and severe deterioration from blight and wet rot due to the wet conditions at lifting time.

Sugar - beet harvesting continued under very difficult conditions and dirt tares were high. Crops were heavy and the condition of the roots was satisfactory.

World production of jute by countries*

(in 1,000 lb.)

Country	Year of harvest 1946-50 (*average*)	1958	1959	1960 (*preliminary*)
Pakistan	2,063,164	2,400,342	2,145,247	2,250,424
India	910,291	2,063,200	1,819,200	1,880,000
Brazil	22,476	68,872	80,821	105,821
Taiwan (Formosa)	13,705	37,690	52,950	37,478
Burma	†	6,252	13,440	22,400
Thailand	3,321	6,413	6,618	8,818
Japan	1,748	1,962	1,521	1,543
Other countries‡	52,232	43,200	24,400	31,830
Total‡	3,066,937	4,627,931	4,144,197	4,338,314

* Excludes mesta and other jute-like fibres wherever separation is possible.

† Not available.

‡ Excludes China and the U.S.S.R.

Acknowledgment is made to *For. Crops. & Mark.* for much of the information contained in the above reports.

New Publications

The Pineapple

By J. L. Collins. Pp. 294. World Crops Books (general editor, Prof. N. Polunin). Leonard Hill (Books) Ltd., London, 1960. Price 60s.

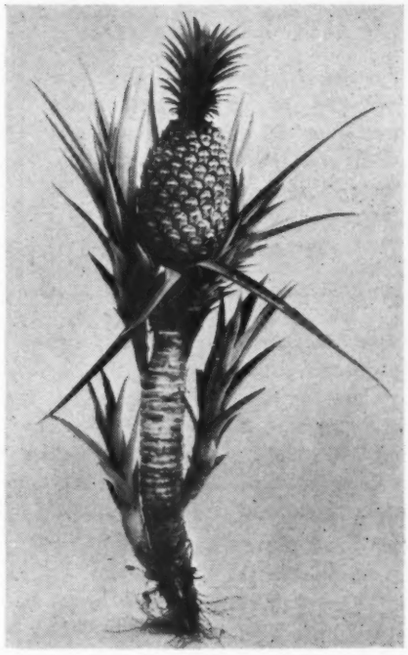
This is the first volume of World Crops Books, a series on individual crops, or groups of crops, of world importance. It sets a high standard for the series and is a valuable contribution to agricultural literature.

The book is divided into three parts: botany, cultivation and utilisation of the fruit. It commences with an interesting chapter on the history of the pineapple, which is indigenous to South America. During the Middle Ages, many varieties were introduced into other tropical countries, but it was not until about the end of the last century that the canned fruit made its appearance and a world-wide trade was established.

The author gives a botanical key to the genera and species and notes on ecology of the species. Discussing the principal varieties and regions of cultivation, Dr. Collins shows how the Cayenne predominates in importance in the chief production areas of the world. The morphology and anatomy of the Cayenne under Hawaiian conditions is described in detail, very adequately illustrated by a number of diagrams and plates.

The author realises, however, that, although important, the Cayenne variety has characters in which improvement is desirable. He gives a list of the important characters of varieties and species which have been used in pineapple breeding, but considers that hitherto most of these have contributed so little that is desirable and so much that is undesirable that they are of little use in breeding. He appears to look to the little-known region in which the Cayenne originated in the hope that other members of the hybrid population may be found which are more suitable for breeding.

The reader will find complete data on the cytology and genetics of the pineapple plant and a comprehensive description of the technique of pineapple breeding and the results achieved thereby. Information is also given in Part 2 on diseases, abnormalities and pests, and on the influence of environmental variation upon development.



A pineapple plant from which leaves have been removed to show appendages of the stem. Starting at the base, they are: roots, sucker, shoots, hapa, slips, peduncle, peduncle leaves, fruit and crown

Diseases and abnormalities are described in some detail, but little appears to be known regarding their control. The term 'pest', remarks the author, has been defined as 'any thing or person that is noxious or troublesome. . . . Some pests attack the roots, some the growing plant, and others the fruit after it has reached maturity. In the last situation, the mature fruit is sometimes not only attacked, but carried completely away from the field by both young and adults of the erect vertebrate, *Homo sapiens* L.'. The author does not, however, suggest any really drastic method of controlling this pest.

As a geneticist, Dr. Collins writes brilliantly on the botanical aspects of this crop. The chapter on cultural methods, however, merely gives an account of accepted practices without critical examination. The economics of pineapple cultivation, the effect of cultural methods and the results of the use of fertilisers on yields are not dealt with. It is to be hoped that these omissions will be made good in the next edition.

On the other hand, an interesting account of the canning industry is given in Part 3. Here the author assumes that canning commenced almost simultaneously in Hawaii and Malaya at the end of the last century, and that Hawaii subsequently furnished the pattern for the industry in several other countries. He is perhaps unaware that a pineapple canning industry was founded in Penang and Singapore as early as 1888.

Hawaii has furnished the pattern as regards mechanisation, but it is doubtful whether Hawaiian cultural practices have had a great impact on methods used in other countries. Hawaiian cultural practices have been dictated by scarcity of land and high cost of labour, conditions which have less force in a number of countries engaged in pineapple canning.

Another writer has stated: "The pineapple industry of Hawaii is not only the most highly mechanised agricultural industry in the world, but also an interesting example of the triumph of modern science over natural processes in that the same land has been repeatedly and successfully planted with the same crop for well over 50 years'. Dr. Collins has outlined the methods used to maintain this monoculture system, but he fails to convince one reader at least that the results justify the system. Soil fumigation, for instance, cannot be omitted without serious depression of fruit yields and the amount of fumigation necessary is constantly increasing. This aspect of the subject appears to disturb the author—as well it might—for he indicates that soil erosion is taking place in Hawaii, pointing to the desirability of introducing crop rotations. Is it possible that Hawaii may yet learn a good deal from a study of methods of pineapple culture in other countries?

Dr. Collins has written a scholarly and interesting book which assuredly will be widely studied. The publishers are also to be congratulated on the attractive presentation of the volume and the excellence of the numerous illustrations.

D. H. GRIST

Rice in Surinam

The Wageningen Rice Project in Surinam by T. P. M. de Wit. Published by Mouton & Co., The Hague, 1960. Pp. 293. Illus. In English with Dutch summary. Price not stated.

The Wageningen project is a mechanised rice farm of about 15,000 acres which has been carved out of the virgin swamps and forests of the coastal plain of Surinam in Dutch Guiana during the period 1947 to 1957. Though it was originally intended to resettle Dutch farmers, this plan was abandoned and the project has been run as a large-scale undertaking by a semi-governmental Foundation for the Development of Mechanised Agriculture in Surinam.

The book is the story of the scheme from its very inception and forms one of the very few comprehensive accounts of the establishment and operation of a fully mechanised rice farming project anywhere in the tropics. As such it will be of tremendous value, not only in the West Indies and South America, but also to Africa and the Far East.

Besides the actual farm, the project comprises the new township of Wageningen, a rice-processing plant, a river harbour for ocean-going vessels and a pumping station controlling the polder irrigation and drainage systems. Rice is grown as a monoculture and all the operations are entirely mechanised, with tillage, direct sowing (*i.e.* no transplanting), weed control, combine harvesting and bulk removal of produce. Puddling is the standard practice and the main crop is grown from April to September; a second crop is grown on a quarter of the area in rotation from October to March.

The whole story is given in detail, with information on the climate, soil (an impermeable heavy clay), the original vegetation, land reclamation (empoldering, drainage, forest clearance by poisoning and by machinery, levelling and ploughing), tillage, sowing, weed and pest control, fertilising, harvesting and transport.

The labour force employed is equivalent to one man to some 60 acres and in the years 1954-58 yields have averaged 2,600 kg./ha. (paddy at 14% m.c.). Because of the heavy initial reclamation costs, and the unexpected drop in world market prices for rice in 1953-55, the project has up to now been run at a loss. However, the general feeling is one of cautious optimism for the future.

The great value of this work lies in the fact that so much of the experience and information gained is not specific to Surinam and can be applied in other under-developed tropical countries.

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(Trade not supplied)

Potassium

Potassium Symposium. Twelve papers read at the 5th Congress of the International Potash Institute held at Madrid, Spain, 1958. Published by I.P.I., Berne, Switzerland. Price not stated.

The theme of this symposium was 'Potash and Water'. The Technical Council of the International Potash Institute considered that the time had come to leave the problems of fertile, well-watered countries and give more attention to the difficult problems of countries with a dry climate. For this reason Spain was chosen as the venue.

The four papers in the first session deal with the fertiliser problems of Spanish agriculture; the next four deal with the water-potassium-plant relationship; the next with the water-potassium-soil relationship; and the last four with the special problems of potassium in regions with a water deficiency or an excess of water.

The 16 papers are in either Spanish, French, German or English, without translations. The introduction and the closing address by His Excellency Miguel Echegaray are given in all four languages; the latter gives a short summary of each paper, so that it is an easy matter to select any paper for full translation.

The papers are of an advanced character and new theories and interesting explanations are put forward to explain the differences between potash manuring and its effects in wet and dry conditions. The thesis is offered that the irrigation of crops with brackish waters, formerly regarded as useless, is made possible with the aid of potash applications, relatively small in quantity in comparison with the total content of salt in the irrigating waters.

F. C. COOKE

O.E.E.C. Publications

Agricultural Regions in the European Economic Community. Report No. 27, 1960 Series. Pp. 54 and five pull-out maps. Price $1.50 or 10*s.* 6*d.*

Grass, Clover and Lucerne Trials. Report No. 23, 1960 series. Pp. 235. Price $2.50 or 14*s.* This and the above publication were prepared by the European Productivity Agency of the Organisation for European Economic Co-operation.

Further Problems in Agricultural Policy. Vol. 1. Fourth report on Agricultural Policies in Europe and North America, prepared by the Ministerial Committee for Agriculture and Food. Pp. 354. Price $4.50 or 27*s.* 6*d.*

All obtainable from H.M. Stationery Office, P.O. Box 569, London, S.E.1, or local sales agents.

Annual Reports

Institute for Research on Storage and Processing of Horticultural Produce. Annual Report for 1958. Pp. 48. Obtainable from the Instituut voor Bewaring en Verwerking van Tuinbouwprodukten (I.B.V.T.), Haagsteeg 6, Wageningen, The Netherlands. Price not stated.

Tea Research Institute of Ceylon. Annual Report for 1959. Pp. 97. Obtainable from the Tea Research Institute, St. Coombs, Talawakelle, Ceylon. Price not stated.

Tanganyika Agricultural Corporation. Report and Accounts for 1958-59. Pp. 100. Obtainable from the Tanganyika Agricultural Corporation, P.O. Box 113, Dar Es Salaam, Tanganyika, East Africa. Price not stated.

Colony of Fiji, Department of Agriculture. Annual Report for 1959. Pp. 24. Obtainable from the Legislative Council, Suva, Fiji. Price not stated.

Rubber Research Institute of Malaya. Annual Report for 1959. Pp. 142. Obtainable from the R.R.I. of Malaya, Kuala Lumpur, Malaya. Price Malayan $3.

Machinery and Equipment

Harrows in Power Farming*

F. C. COOKE

This is an account of an interesting field demonstration of harrows which was recently arranged on a farm near Shaftesbury, in the county of Wiltshire in England.

HARROWS are used for a variety of purposes, so that it is not surprising that a leading firm of manufacturers are producing about 200 different types of harrow based on variations in size, shape and arrangement of the tines and in the operating principle to suit different purposes and soil conditions.

In general, harrows are required in arable land for the following main purposes: preparing and finishing seedbeds, covering seeds, introducing fertilisers, spreading manure and droppings, aerating the top soil by breaking up the surface crust, and control of weeds by successive tillering.

So far as grassland maintenance is concerned, they are used for aerating pastures by scratching out moss and dead vegetation, for working out and collecting couch grass, *Agropyron repens*, and for cutting up the surface of grassland before ploughing. Thereafter other types of harrows are used for breaking up the clods, working the land and bringing out buried roots and breaking up matted grass.

With so many different soil types and so many purposes, design naturally varies. Broadly speaking, there are six main types: the frames may be flexible or rigid; they may be one-sided or reversible; the tines may be sprung or rigid.

Two main types of rigid harrow have been developed—the zigzag and the diamond—and in both cases the tines are carried at the intersections of the cross-members of the carrying frame. They are operated in sets of from three to 12, with a corresponding working span of 7-35 ft. They may be supplied with straight, bent or chisel-shaped tines, and each tine should be fitted with a lock-nut to prevent it from becoming loose.

Flexible harrows range from the simple chain harrow, with short stubby tines forming a steel mattress which closely adheres to and adjusts itself to the surface of the ground, to heavier types with longer and stouter tines of various shapes for heavy grassland and arable operations.

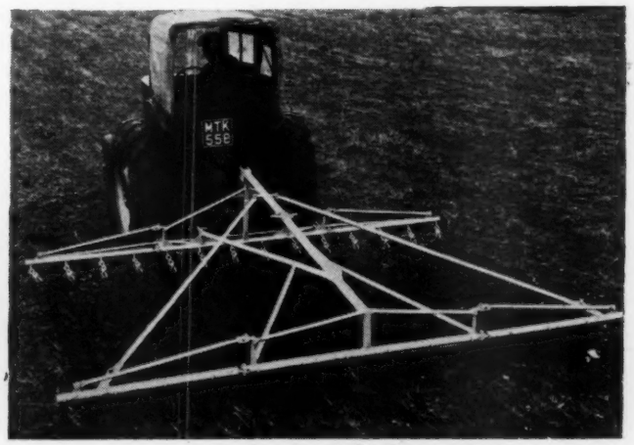
With all these groupings, there are variations in length, shape and weight of tine, according to the lightness or heaviness of the work to be done and the lightness and heaviness of the soil.

The depth of penetration of most tines of harrow is small, depending on soil texture, the size and shape of the tine and, of course, the total weight of the harrow. Straight tines with points inclined forward tend to go deeper than straight or vertical tines, which do not pull out so much rubbish. Curved tines are used both on harrows and deep cultivators; if they are curved forward, they dig deeper and pulverise the soil; if they are turned back, they can be used to stroke a seedbed to obtain a fine finish on light soils or to give a light harrowing to fine turf.

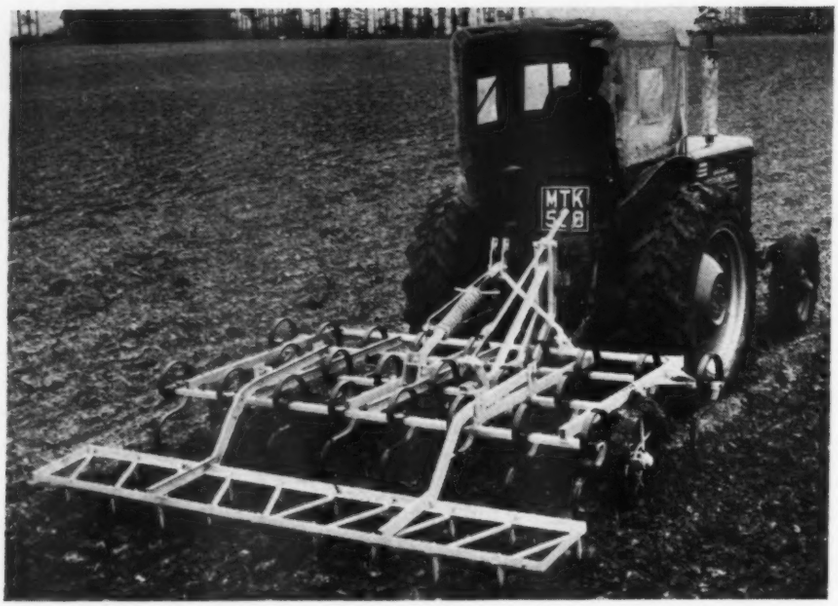
Flexible one-sided harrows with short single tines, either of hard steel rod, stubby spear points or flat tempered steel with sharp cutting edges, are used for grassland renovation. The first type are scratchers designed to work down fallows, for surface weeding and for working out and collecting couch grass; the second are for removing moss, fog and dead grass from an old pasture; and the third are for cutting up a hard mat and bringing coarse and dead overgrowth to the surface.

Flexible reversible harrows are dual-purpose implements. On one side are

*Prepared from information supplied by P. J. Parmiter & Sons Ltd., an old-established firm of makers of flexible and rigid harrows.



Left: *Tubular carrier frame and flexible chain harrow in the transport position.* Right: *Parmiter's flexible chain harrow in use*



Parmiter's 23-tine, three-row spring tine with spring-loaded top link and following rigid spike harrow

short tines for aerating a seedbed, scratching pastures, spreading manure and reducing mole hills; on the other side the same tines are longer for breaking up clods on ploughed land and for preparing seedbeds.

These flexible harrows may simply be dragged behind a harrow either singly or, using a whippletree or drawbar, in sets of three, five or more, or they may be mounted on a tubular frame and carried on the three-point hydraulic linkage. This frame allows easy cleaning simply by using the hydraulic lift; a set of harrows can also be folded on it for quick transport through gates to other fields and for use in otherwise inaccessible spots. Extra light harrowing is also possible by operating with a partial lift.

Finally, there are large hook harrows with tines either of sprung steel or rigid, both types mounted on a rigid frame. Depth control can be arranged by means of two carrier wheels which can be adjusted for height. Universal pick-up points are fitted for attachment to the hydraulic lift of the tractor and adjustable spring loading of the top link can be included to allow for uneven working conditions.

The 'Youngster' three-row, 12-tine, tractor-mounted harrow is a special unit designed for operating where working space is restricted, and it is used in such row crops as hops, vines, pole beans and soft fruits. By altering the tine settings cultivations can also be carried out in potatoes. The h.p. requirements of this implement were stated to be 1 h.p. per tine.

The working life of any of these harrows naturally depends on the materials of construction and to a lesser extent the design. The use of high-carbon steel will ensure that a flexible tine harrow will last for approximately 12,000 miles, equivalent to a capital cost of less than half a cent per acre.

Power Farming with One Vehicle

A Land-Rover descending a 1 in 1 slope

THE *Dowty* hydraulic p.t.-o. and rear-mounted hydraulic lift and the three-point linkage produced by the *Adrolic Engineering Co. Ltd.* are together responsible for the remarkable versatility of the *Land-Rover*, now available with petrol and diesel engines and in two versions: the 'Regular 88' and the 'Long 109'. With three passengers, including the driver, the '88' has a payload of 1,000 lb. on the road or 800 lb. for cross-country work; the corresponding figures for the '109' are 2,000 lb. and 1,800 lb.

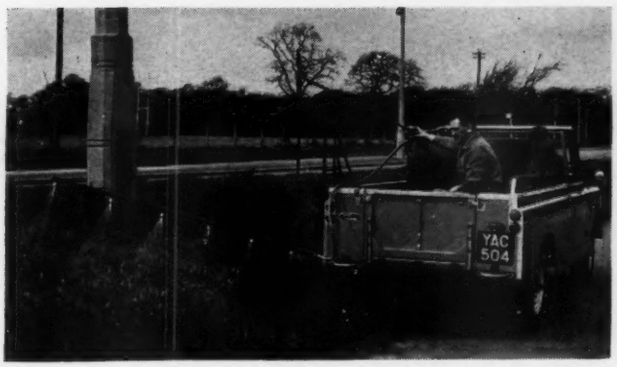
The following is a selection from a long list of farm equipment and implements which are recommended by the company for use with the Land-Rover:

Air compressors—a small unit by *Lawrence Edwards & Co.* is a useful accessory for tyre inflation and for operating a spray gun for anti-malarial work and for whitewashing, spray painting and spray oiling agricultural machinery and implements. A larger unit by *B.E.N. Patents Ltd.* provides ample power for farm workshop tools and for powering mechanical hedge-cutters.

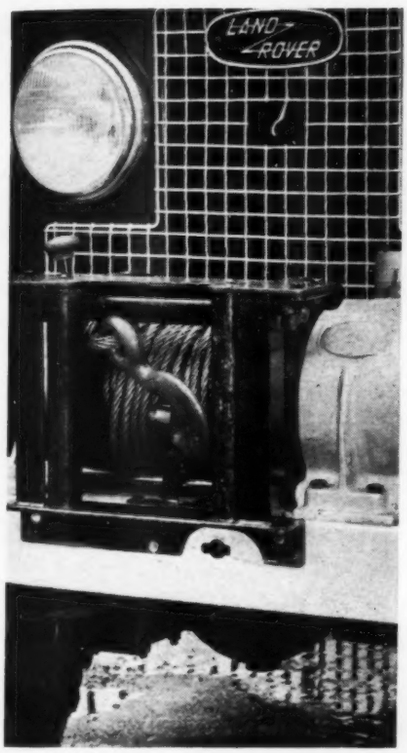
The *bulldozer blades* and *snow-ploughs* manufactured by *J. B. Howie Ltd.* will appeal to those living in remote places for road grading, bench terracing and making minor earthworks and for clearing the snow away from the approach roads to farms.

Agricultural education by visual aids is essential for the advancement of agriculture in backward and primitive countries. The 'Cinerover' is a self-contained *mobile cinema* unit by *Cintec Ltd.* for operation in the open air after dark, using a projector powered by the engine of the vehicle.

Syndicates of farmers, co-operative



Left: *Concrete mixer by McConnel which can be filled at shovel height and moved wherever needed on a site.* Right: *With this Evers and Wall sprayer, fitted to a Land-Rover, spraying can be carried out at up to 10 m.p.h.*



The hydraulic transmission for this Land-Rover winch gives it flexibility in operation and installation

societies, large farms and contractors should be interested in the Armhead *concrete mixer* offered by *McConnel Ltd.*, which is fitted to the rear of the vehicle and powered by the rear p.t.-o. The bowl is conveniently arranged at shoulder height.

The Land-Rover and the 'Dandy'—a *forage harvester* by *Silorators Ltd.*—are described as a perfect combination for high-speed pasture topping, either for silage making or for what is called zero-grazing. The loads can be delivered either forward, sideways or to the rear into a forage wagon or trailer.

Grass cutters for the improvement and reclamation of neglected grasslands can also be drawn behind the Land-Rover. Those recommended include the *Hayter* rotary cutter with its two wing extensions, giving an effective width of 14 ft., and the *Mitchell* 'Dreadnought' gang mowers, which are flexibly attached in gangs of three or five, the latter giving an effective width of over 11 ft.

For pruning, artificial pollinating, foliar spraying and fruit harvesting there is the *L25 hydraulic platform* offered by *Simon Engineering (Midlands) Ltd.* It consists of a hinged arm, which carries a bucket and is operated hydraulically from the centre p.t.-o. of the vehicle or by an auxiliary power unit. The control levers are in the bucket and the man inside can quickly raise himself and his working gear from ground level to a height of 26 ft. or move the arm round in an arc of 300°.

The 'Salopian' *manure spreader* by *S.K.H. & Son* has been specially designed for the small farmer who does not possess a tractor with a rear p.t.-o. It can be drawn behind the Land-Rover. Although it weighs only 15 cwt., it has a carrying capacity of 25-30 cwt. of manure and the wheels actuate the distributing mechanism.

There is also a mechanical *sawbench*, which is supplied by *F. W. McConnel Ltd.* for fitting to the rear p.t.-o. of this very versatile vehicle. It consists of a steel table top 31 in. x 48 in., with a 30-in. circular saw, and may be used for cross-cutting and ripping lengthwise fence posts, planking and wooden rails.

The McConnell 'All-work' sawbench for cross-cutting and ripping lengthwise. On arrival at the site the sawbench is lowered, the jacks adjusted and the work can begin. When sawing is finished the bench is raised again and the Land-Rover driven away

Land-Rover fitted with workshop conversion by Price's (Earl Shilton) Ltd.

Crop spraying is another operation that can be carried out from this vehicle. *Evers & Wall Ltd.* offer a sprayer for desert locust control which produces an atomised spray using the exhaust gases from the engine; they have also a fore-mounted boom sprayer and with this it is possible to spray 80-90 acres a day travelling at 10 m.p.h. The *Allman* 'Plantector' Model 60 field sprayer is rear-mounted and its 60-gal. spray tank is carried in the body of the vehicle.

For soil moving there is a *tipping box* with a capacity of about 7½ cwt. which is offered by *Adams & Benson (Agricultural) Ltd.* This fits easily on to the tailboard fitments and is so balanced that it can be tipped and emptied by the driver. It can also be used for carrying sand, rubble, liquids or mixed concrete.

For clearing bracken, thistles and similar weeds which are encroaching on pastures can be effected with the *Holt weed breaker*, a heavy three-gang trailer-type implement.

Finally, there is the important matter of getting out of trouble or of getting other farm vehicles out of trouble. The makers of the Land-Rover offer a useful extra, such as a forward-mounted winch, a front capstan winch and various devices for towing which can be fitted front or rear.

Letter to the Editor

Sir,—Under the heading 'Controversial Issue' in the editorial comment of the November copy, on the subject of ploughing matches, it is suggested that long-established practice is not necessarily the best and also the man who can plough exactly parallel furrows closely following an unstaked contour is a better ploughman than one who ploughs straight and true. This may be true, but I submit that farmers in Great Britain would be glad if they could find yet another method of ploughing to get water off their land in view of the continuous rains during this autumn.

The object of contour ploughing is to retain moisture when the weather is dry and prevent soil erosion when heavy and torrential rains fall. This being so, contour ploughing becomes part of a soil conservation plan. Contour ploughing contests are staged where soil conservation is necessary and the rules call for a similar high standard of work as in ordinary contests. The main difference, of course, is in adhering to the contour boundary instead of having straight furrows. Although this difference is there, the plough has still to perform the same function of turning over furrows of equal width and the same depth, good outs and ins and good finishes.

However, we have to bear in mind that in ploughing competitions the organising committee has to endeavour to provide an area of land where the ploughing conditions are as near as possible the same, in order to give all competitors an equal chance of doing well. This, in turn, enables the judges to do their job satisfactorily. These functions also rely to a large extent on spectators for revenue.

Having actually witnessed a contour ploughing contest, I felt that there was not much interest for the spectator. The judging has largely to be undertaken by expert soil conservationists who are not expert ploughmen, with the result that the standard of ploughing does not improve. In other words, I have a feeling that more points would be awarded for the accurate following of contours at the expense of a high standard of ploughing. The two issues are so different that I feel they cannot be compared one with the other. There is obviously room for both types of competition: the usual one for bettering the standard of actual ploughing and the other with the emphasis on soil conservation.

J. Gass.

Ransomes Sims &
Jefferies Ltd.,
Ipswich,
England.

Agricultural Chemicals and Supplies

Hidden Enemies

Foliage and fruit pests rarely remain undetected for long and by comparison pests living in the soil receive only scant attention. This apparent disregard of the soil insect problem has been due, in large measure, to the lack of a really effective insecticide to meet the requirements of treatment within the soil of these hidden enemies of the farmer.

Such pests attack crop plants either by feeding on the newly planted seed or by damaging or destroying the root system of the crop, or by feeding on the underground portion of the stem of the plants, or by making holes in the tubers, *e.g.* potatoes.

The resulting losses can be considerable. There may be a severely reduced stand following widespread attack on the planted seed; yields and crop quality may be lowered through extensive root damage; the plants may be stunted or lacking in vigour; plant resistance to drought and to attack by other pests and diseases is reduced; and the effective uptake of fertilisers and manures may not be possible, resulting in the wastage of these materials and smaller crops.

No reliable estimates of the value of the losses caused by soil insects throughout the world can be made, because such calculations are virtually impossible. One estimate is that insect pests reduce world crops by 30%, and much of this damage actually takes place in the soil or is inflicted by aerial pests which have spent their early life underground as grubs or maggots. Such hidden enemies can be controlled by the use of *aldrin*, according to an attractive brochure which is obtainable through our Reader Service.

Wide-span Glasshouse

A feature of the world-famous Chelsea Flower Show 16-19 May will be a glasshouse of unique design, which is designated by the manufacturers—*Burt Boulton & Haywood Ltd.*—the 'Clear Span' glasshouse. Its remarkable truss construction gives a clear floor area, 30 ft. wide, which virtually eliminates shadows, allows more light and, of course, makes it possible to plan the beds without having to allow for any obstructions.

Boron and Soya Beans

The frequent association of *boron* deficiency with over-liming has received considerably more attention than has the association of boron deficiency with the use of potash fertilisers. Recently C. M. Woodruff and J. L. McIntosh, of the Missouri Experimental Station, carried out experiments to determine which element might be responsible for the poor growth of soya beans at high levels of potassium in the soil. They used fertiliser mixtures containing seven additional elements and other mixtures with one of each of the seven omitted. Three rates of application to the soil and three replications were used.

They found that the soya bean plants grew perfectly in all cases except where boron had been omitted. The rates of application that grew satisfactory plants were 1 lb., 2 lb. and 4 lb. per 2 million lb. of soil.

Using nine levels of potassium, ranging from zero to 20%, they further found that the boron deficiency increased in severity with increasing amounts of potassium, but the addition of boron at the rate of 1 lb. per million lb. of soil provided sufficient of this element for the normal growth of the plants at all levels of potassium in the soils.

A warning is given that excess boron is toxic to soya beans, so that there must be no localised concentrations of this element. It must be uniformly distributed through the soil and should not be applied with the seed when it is drilled into the soil. Its proper use is in mixed fertilisers that are broadcast and mixed in the soil.

For Woody Weeds

Ammonium sulphamate, $NH_4SO_3NH_2$, is offered by *Albright & Wilson (Mfg.) Ltd.* as a herbicide against woody and semi-woody weeds. It is toxic through the soil as well as through the leaves of the plant. It decomposes in the soil to nitrate and sulphate, which act as nutrients for the crop which may subsequently be grown in the treated soil. It disappears completely from the soil in four or five months and does not present any serious health hazard to the user.

Horticulturists will note with interest that it has been used with success to inhibit germination of weed seeds in soil and compost. It is being used to prevent the regrowth of suckers from stumps after tree felling; rhododendron, hazel and oak can be controlled

by spraying the cut stumps in early summer with a solution containing 3 lb. of the herbicide in a gallon of water within three days of cutting. For killing standing trees a deep frill girdle is cut about 12 in. above ground level and packed with crystals of the sulphamate. This treatment is best carried out in the growing season, it is stated.

Disinfestation Service

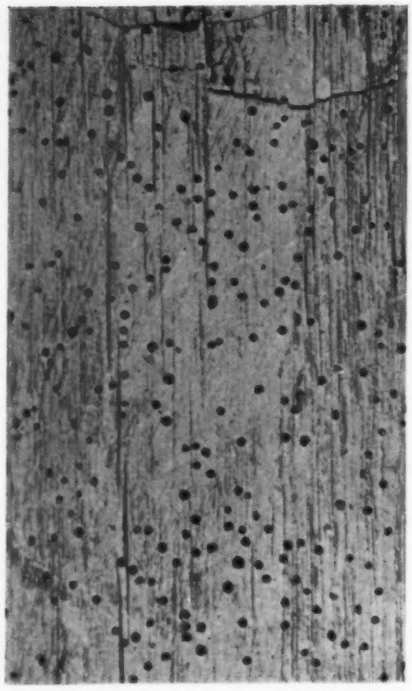
The *Pest Advisory Serivce* is an organisation for dealing with serious infestations by pests and vermin which are destructive of food or property, or threaten public health. This organisation will send experts to examine and report, for example, on the condition of historic mansions or on necessary measures for controlling a plague of rats in a town, or make recommendations for the extermination of cockroaches in ships, warehouses and flour mills.

This organisation recently carried out a major operation at Bahrein in the Persian Gulf—the control of a plague of rats, which are not only destroyers of foodstuffs, but also carriers of plague and other diseases.

The experts of this organisation are trained to carry out systematic examinations of buildings and advise on the steps to be taken to deal with wood-boring insects, such as woodworm, otherwise known as the furniture beetle, *Anobium punctatum*, the death watch beetle, *Xestobium rufovillosum*, the house longhorn, *Hylotrupes bajulus*, and the powder post beetle, *Lyctus* spp.; they also advise on the treatment necessary to deal with dry rot, *Merulius lacrymans*, and fungi associated with damp conditions, such as the cellar fungus, *Coniophora cerebella*, which often gives a deceptive veneer of hard wood over a rotten core of soft decayed material. The Service is also called in to control pests of every description—ants, flies, moths, cockroaches, starlings and, of course, rodents.

Two Weedkillers

Du Pont International have established a factory at Nemours in France for the manufacture of two weedkillers which have been developed and proved in the U.S.A. These are 'Karmex' diuron and 'Telvar' monuron; the first is described as being particularly suited for the control and elimination of weeds in grapes, sugar-cane, citrus and cotton, while 'Telvar' is designed as a total weedkiller for cleaning up industrial sites, roads and railways.



Piece of wood taken from an old building, showing severe woodworm infestation

Peat Pots for Plants

From the Republic of Ireland comes news of a recently completed factory for the manufacture of peat pots designed to be used by commercial growers and horticulturists to prevent the check in growth which normally occurs through root shock and damage during transplanting. With these pots both the plant and the pot are planted together in the ground and the young seedling is not disturbed.

The factory, which has been established by *Jack Pot Ltd.* with the co-operation of Ireland's Industrial Development Authority, has a capacity of 115 million pots a year and the company is producing them in 11 designs —six sizes round and five square.

The materials used are sphagnum peat moss, wood fibre and chemical nutrients. These are made into a thick slurry, formed into pots in automatic machines at high speed and then they are dried and sterilised in ovens.

The new Birr factory, 70 miles from Dublin, will be exporting its products first of all to the U.K. and Canada and subsequently to other countries in Europe.

Reader Service

For further information on any item reviewed in this issue please use the card provided or write to:

Reader Service,
WORLD CROPS,
Leonard Hill House,
Eden Street, London, N.W.1,
England

Three-way Fungicide

' A three-fold cord is not quickly broken '.

A compound fungicide by *F. W. Berk & Co. Ltd.* is claimed as an effective answer to severe attacks of potato blight, for in ' M.C.O.Z.' three lines of fungicidal research and experience converge.

It was first found that when phenyl mercury chloride was combined with copper oxychloride, 3 lb. of the resulting compound, ' M.C.O. ', was as effective as 5 lb. of copper oxychloride used alone. Since then good results have been obtained by combining zineb with copper sprays and it was thus a logical step to combine all three. ' M.C.O.Z.' dispersible powder, containing 35% zineb, 25% copper and the safe but adequate 0.3% mercury, was the result. The components are micronised, ensuring an intimately mixed formulation of fine particle size.

Only 3 lb. of this formulation are necessary to treat an acre of potatoes, either as a high-volume spray in 100 gal. of water or as a low-volume spray in 3 to 5 gal. of water or oil from the air.

Since the amount of copper employed is only half the amount used in copper oxychloride or cuprous oxide, it means that ' M.C.O.Z.' is kinder to the potato foliage and phytotoxicity is no problem. Although its mercury component makes it unsuitable for the control of diseases of certain other plants, such as vines, its use is not limited to potatoes.